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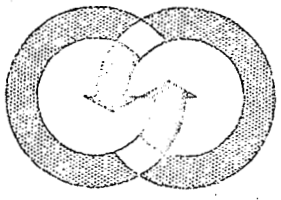

APPLIED RESEARCH DEVELOPMENT

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EVALUATION OF DIELECTRIC MATERIALS IN A SIMULATED SPACE ENVIRONMENT

Report No. 04232-F

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By

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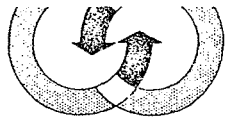
1-b. APPLIED RESEARCH DEVELOPMENT

TABLE OF CONTENTS

	Page
List of Illustrations	iii
List of Tables	iv
Abstract	v
Introduction	1
Experimental Techniques	7
Results & Conclusions	18
Sample Rating	18
Condensible Analysis	30
Appendix A	51
Data Tabulation	52
Typical Spectra	81

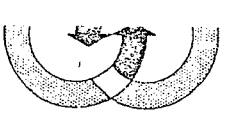
LIST OF ILLUSTRATIONS

Figure		Page
1.	Vacuum Train	8
2.	Test Chamber and Lead Circuitry	11
3.	Ardel Dielectric Measuring Fixture	13
4.	Dielectric Vacuum Test Fixture	14
5.	Ion Pumps	15
6.	Infrared Spectrophotometer	17
7.	Test Chamber and U-Trap	31



LIST OF TABLES

Table		Page
1	Materials Tested	4
2	Sample Rating	23
3	Dissipation Factor	52
4	Insulation Resistance (Before, During & After Vacuum Exposure)	57
5	Weight Stability	62
6	Insulation Resistance (Before & After Vacuum Exposure)	66
7	Dimensional Stability	67
8	Hardness	68
9	Dielectric Strength	71
10	Condensible Film	74
11	Capacitance	76

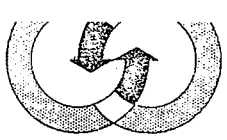


ABSTRACT

During the course of this program ARDEL CORPORATION has evaluated many of the more common materials presently in application in spacecraft. This evaluation has involved the exposure of 225 materials samples to vacuum conditions. Temperatures from -100°F to +300°F have been coupled with vacuum of 10^{-6} to 10^{-9} torr for these studies. Data have been obtained for weight loss, outgassing of the samples, recondensation of outgassed materials and changes in dielectric properties in some of the materials.

A total of 42 materials were studied under this program. Wherever possible a complete description is given for each of the materials.

This program had as its objective to determine techniques for testing, explore these as test procedures and establish a means of obtaining useable data. In addition to this a large amount of valuable data has been obtained. ARDEL CORPORATION has as its objective to interpret this information, which will be formulated as a supplementary report.

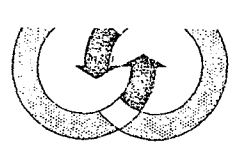


INTRODUCTION

The ever increasing cost and complexities demanded in the field of space technology in the past few years, together with the political consequences of marginally successful space missions, have made it necessary to undertake more sophisticated research on the effects of high vacuum environment. Recent construction of large space simulation facilities have made the first step towards the studying of the effects of space environment on complete vehicles. These studies however are extremely complicated by the necessity to evaluate properties such as friction, decomposition and changes in electrical parameters of the basic materials.

A careful look must, therefore, be made at both the components and materials from which the components as well as other parts of the spacecraft are fabricated. Realistic tests must be designed which will provide the necessary data for design of reliable spacecraft. Spacecraft will see temperatures in excess of 250°F while under vacuum of 10^{-12} torr or better. The duplication of this environment in ground test facilities is most difficult if not impossible. Even on a research scale, the necessary equipment is costly and time consuming to construct, checkout, and then apply to realistic testing. It must be pointed out however, that it is not the space environment but rather the effects of the environment which must be duplicated.

Current high vacuum techniques have advanced to the point where we may now obtain 10^{-8} to 10^{-10} torr in the laboratory. In the simulation of space these pressures are equivalent to altitudes of 450 to 500 miles.



There are a number of techniques currently in use by which we may obtain these high vacua. Basically, two techniques stand out: Diffusion pumping and Ion gettering pumping. To date the most common of these techniques is oil diffusion pumping. By the use of this technique it is possible to reach 10^{-10} torr with cryotrapping. Even so there are certain outstanding limitations. In using silicone diffusion pump oils or hydrocarbon fluids it is impossible to prevent the backstreaming of pump oil degradation products into the vacuum chamber. In experiments involving lubricant studies, vapor deposited micro circuity, chemical synthesis etc., it has been shown that contamination is always present. In experiments with organic materials, such as weight loss or those which would require chemical analysis of degradation products, no extraneous organics can be tolerated within the vacuum system. Therefore, the elimination of elastomeric seals, as well as hydrocarbon or poisoning types of silicone oils, is imperative. A second type of diffusion pump utilizes mercury as a pumping fluid. Even though mercury has a vapor pressure of 10^{-3} torr at room temperature, efficient cooling of the wall of the diffusion pump can and will prevent gross backstreaming into the vacuum chamber. By coupling a liquid nitrogen trap with a mercury diffusion pump, the vapor pressure of mercury can be reduced to 10^{-23} torr or better. The more practical working ranges for a mercury diffusion pump are within pressures of 10^{-5} to 10^{-7} torr. It is possible to achieve pressures lower than 10^{-7} torr with a mercury diffusion pump, however, pumping speeds are greatly reduced. Should backstreaming occur into the test chamber itself, the mercury is found to be quite inert when chemical analyses of the sample degradation products are performed.

The second pumping technique utilizes cold cathode discharge in a magnetic field to sputter reactive metal. The gases which are pumped into this type of pump are occluded by a film of reactive metal. The film itself should be developed by sputtering techniques rather than by thermal evaporation. Thermal evaporation has a disadvantage in that it will not permit trouble free operation of the pump for long durations. The production of high vacuum by the technique of sputtering of metal films has been in practice since about 1939.

The following tables list the materials evaluated under this program.

TABLE 1

TABLE OF MATERIALS

Material	-100°F	75°F	150°F	225°F	300°F	Ultra high Vacuum 225°F
Silicone "JC" Series, connector insert, Bendix, Scintilla Division	1a4	1a5	1a3	1a1	1a2	1a6
Silicone "JC" Series, connector insert, Burndy Connector	1b4 1b4	1b5 1b5	1b1 1b1	1b2 1b2	1b3 1b3	1b6 1b6
Silicone "DTK" Series, connector insert, Deutsch Company	1c4	1c5	1c1	1c3	1c2	1c6
Fluorocarbon rubber, "Viton, Special, Connector insert, Bendix, Scintilla Div.	1d4	1d5	1d3	1d1	1d2	
Diallyl Phthalate, #278 Green connector insert, Mesa Plastics	1e6	1e1	1e2	1e5	1e3	
Diallyl Phthalate, #191 Green, connector insert, Mesa Plastics	1e15	1e11	1e14	1e13	1e12	1e16
Diallyl Phthalate, #20062 Brown, connector insert, Mesa Plastics	1e21	1e25	1e23	1e22	1e24	
Diallyl Phthalate #125 Green, connector insert, Mesa Plastics	1e35	1e31	1e32	1e33	1e34	
Epoxy, Glass Filled, connector insert, Mesa Plastics	1f6	1f1	1f2	1f4	1f3	1f7
Phenolic, Glass Filled, connector insert material, Fiberite Company	1g4	1g5	1g3	1g1	1g2	
Silicone, "JC" Series, connector insert, Cannon Electric	1h4	1h5	1h3	1h2	1h1	1h6
Polycarbonate, "Rexolite", connector insert material, Koppers Company	2a5	2a4	2a3	2a2	2a1	2a7
Polyimide, "SP" and "ML", connector insert material, DuPont	2b4 2b4	2b5 2b5	2b3 2b3	2b2 2b2	2b1 2b1	
Fluorocarbon, "Kel-F", insert material 3M	2c6	2c1	2c2	2c5	2c3	2c7

TABLE 1 (cont)

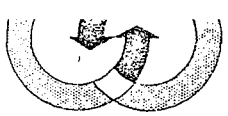
TABLE OF MATERIALS cont.

Material	-100°F	75°F	150°F	225°F	300°F	Ultra high Vacuum 225°F
Polyester, "Mylar", connector insert material, DuPont	2d5	2d4	2d3	2d2	2d1	2d7
Chloro-sulfanated Polyethylene, "Hypalon Rubber, PBW", connector insert material, DuPont	2e4	2e5	2e3	2e1	2e2	
Chloro-hydrocarbon, "Neoprene Rubber-W", connector insert material, DuPont	2f5	2f2	2f1	2f4	2f3	
Polyolefin, "Thermofit", Sleeving, Raytherm Corp.	4a4	4a1	4a2	4a5	4a3	
Polyester, "Mylar", Sleeving, Stone Paper Tube Company	4b4	4b1	4b2	4b5	4b3	4b7
Polyurethane, "Durathane WGE-3", Jacketing, Whitmore Plastics & Cable Co.	6a1	6a2	6a3	6a5	6a4	
Silicone, Jacketing, Bentley-Harris Manufacturing Company	6b1	6b2	6b3	6b5	6b4	6b7
Mystick Tape 7455, Jacketing, 3M	6c4	6c1	6c2	6c5	6c3	
Polyester, Aluminized Mylar, Jacketing, National Metalizing	6d5	6d1	6d2	6d4	6d3	6d7
Nylon, Cable clamps, Dakota Eng., Inc.	7a1	7a2	7a3	7a5	7a4	
Nylon, Cable clamps, Thomas & Betts Corp.	7b1	7b2	7b3	7b6	7b4	
Silicate Rubber, Type 715, cable clamp, T. A. Manufacturing Company	7c5	7c2	7c3	7c4	7c1	
Polyurethane, "793" Potting compound, Coast Pro Seal	8a4	8a5	8a3	8a1	8a2	
Polyurethane, "PR1527" Potting compound, Products Research	8a14	8a15	8a13	8a11	8a12	

TABLE 1 (cont)

TABLE OF MATERIALS cont.

Material	-100°F	75°F	150°F	225°F	300°F	Ultra high Vacuum 225°F
Epoxy, "1368" Potting compound, Furane Plastics, Inc.	8b4	8b5	8b3	8b1	8b2	
Silicone, "Silastic RTV 881", Potting compound, Dow Chemical	8c4	8c5	8c3	8c1	8c2	
Silicone, "PR1930" Potting compound, Products Research	8c14	8c15	8c13	8c11	8c12	
Silicone, RTV-88 Potting compound, General Electric	8c24	8c25	8c23	8c21	8c22	
Silicone, RTV-891 Potting compound, Dow Corning	8c34	8c35	8c33	8c31	8c32	
Silicone, DC501 Potting compound, Dow Corning	8c44	8c45	8c43	8c41	8c42	
Silicone, 295-1 Potting compound, Epoxilite	8c54	8c55	8c53	8c51	8c52	
Silicone, TRV-60 Potting compound, General Electric	8c64	8c65	8c63	8c61	8c62	
Polyester, "Selectron" Potting compound, Pittsburgh Paint	8d4	8d5	8d3	8d1	8d2	
Fluoro-Hydrocarbon, "Aclar", Potting compound, Allied Chemical Co.	8f4	8f5	8f3	8f1	8f2	8f6
Fluoro-Hydrocarbon, "Kynar" Potting compound, Pensalt Chemical Co.	8f14	8f15	8f13	8f11	8f12	8f16
Polyurethane, "Adiprene Rubber-C" connector insert material, DuPont	2g4	2g5	2g3	2g1	2g2	
Fluorocarbon rubber, "Viton Rubber-B", connector insert material, DuPont	2h4	2h5	2h3	2h1	2h2	2h7
Nylon, "X-901", Nylon-Zytel 101, Potting cup, Ply-O-Seal	5a5	5a2	5a3	5a1	5a4	



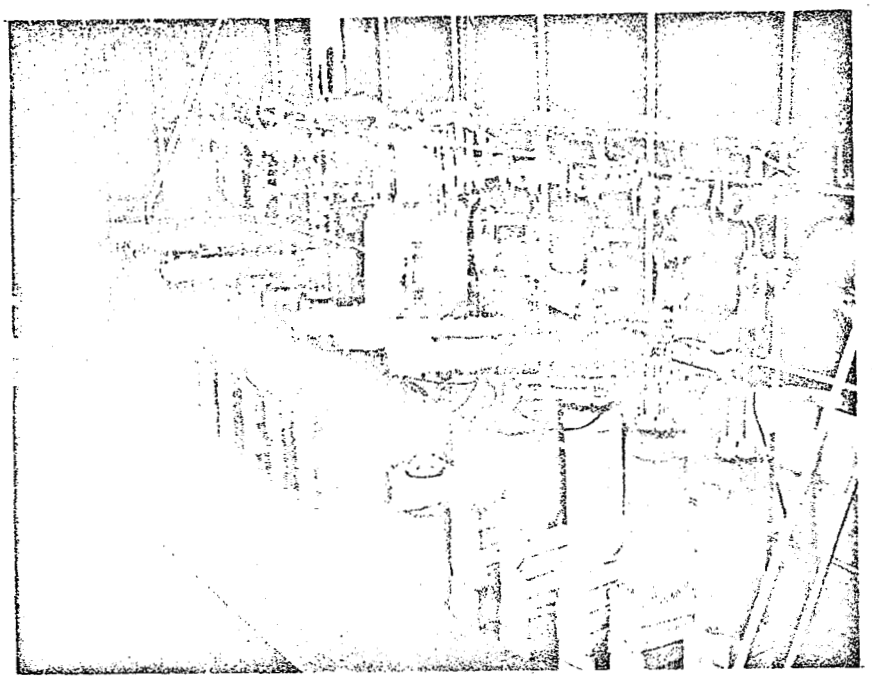
EXPERIMENTAL

The following paragraphs describe the experimental procedures used for the laboratory evaluation of the materials.

The vacuum apparatus, shown in Figure 1 was used to expose the test samples (indivdually) to high vacuum and thermal energy 10^{-6} to 10^{-7} torr. The vacuum train is an all glass system which normally operates in the 10^{-7} torr range.

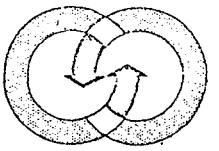
The vacuum train consists of a DuoSeal Welch roughing pump coupled with a three stage mercury diffusion pump using double cryogenic trapping. This prevented backstreaming of mercury into the main manifolds and sample chambers. The two manifolds, connected to opposite sides of the diffusion pump, are each provided with 5 outlets or test ports on them. Cryogenic U-traps were used between each sample chamber and the manifold. These traps prevented backstreaming into test chambers and also enabled the collection of the condensible outgassed products from the test samples.

A Cooke Company ionization gauge at the distal end of the manifold was used to measure the pressure in the vacuum system.



VACUUM TRAIN

Figure 1



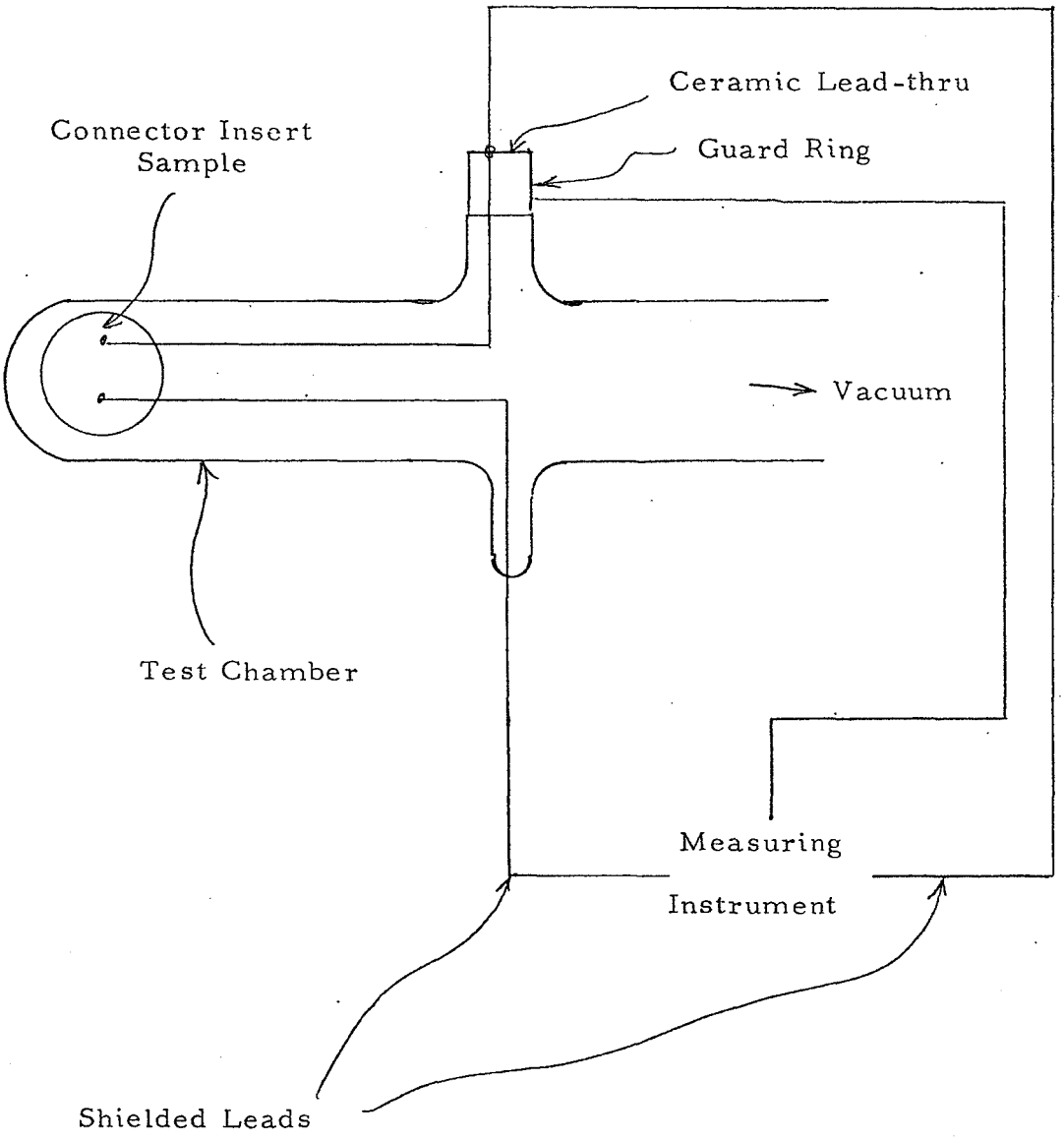
Ultek 100 l/sec capacity ion pumps were used to vacuum test the samples, which passed the gross screening and were compatible with high vacuum and thermal environment. The ion pumps, used for the ultra high vacuum and thermal exposures, were first pumped down empty to determine the ultimate capability of the pumps. The capability was in the 10^{-10} torr range for all of the pumps used. The ion pumps and test chambers were helium mass spectrometer leak checked prior to operation use. Any leakage not detectable by the above technique would be found using an ion gettering pump power supply as a detecting device. Such a leak check was accomplished by pumping into the high vacuum range where a few micro ampers of current are being drawn to ionize the gases. The exterior of the chamber was then covered with helium gas, which was used as a sensing medium. As the helium penetrates through a leak or thin spot on the wall, it is immediately sensed by being pumped into the ion pump proper. Helium is a good detector since it is a small atom and fast. When leak tight the empty chambers had almost the same pumpdown curves for each pump.

In preparation of the samples, white nylon gloves were used for handling before and after vacuum exposure. This excluded erroneous weight loss data and permitted a more rapid pumpdown. All tools used in sample preparation and handling were degreased and thoroughly cleaned prior to use.

The weight of all samples was obtained before and after exposure using an Ainsworth chainomatic analytical balance. Its accuracy was ± 0.1 mg. The measurement of the dimensions of the appropriate samples was achieved by use of Helios calipers, accurate to a tenth of a centimeter.

A type "A-2" Shore Durometer was used to measure the hardness of the samples; it is accurate to ± 1 Duro division on the meter. The dielectric strength of the samples before and after vacuum was measured using an Associated Research Hypot Model 422. The dielectric strength voltage was applied using two circular electrodes (for the disc shaped specimens) which were smaller in diameter than the sample diameter. For the connector specimens two adjacent pins were used as electrodes.

The insulation resistance apparatus for measurement before and after exposure consisted of two circular electrodes and a guard ring for the appropriate sample which were planar or could be made planar. For all samples, which were tubular, a saturated salt solution was used as the electrodes. The tubular samples were bent in a Ushape, ends up, and filled to the top with the salt solution. Then the U-shaped sample was inserted to a specified depth into a beaker filled with saturated salt solution. The insulation measurement was then made with the voltage (500 volts) applied for one minute, after which time the resistance reading was taken. Two adjacent pins were used as electrodes for resistance measurements before, during and after vacuum exposure of connector inserts. The measurements were made using a specially fabricated test chamber shown in Figure 2. The schematic in Figure 2 shows the measuring instrument circuitry used with a General Radio, megohmmeter, Type 862-B. The dissipation factor and capacitance also were obtained before, during and after vacuum using the fixture described above, and the circuitry shown in Figure 2. An Impedance Bridge, Type 1650-A, of General Radio was used to measure these two properties.



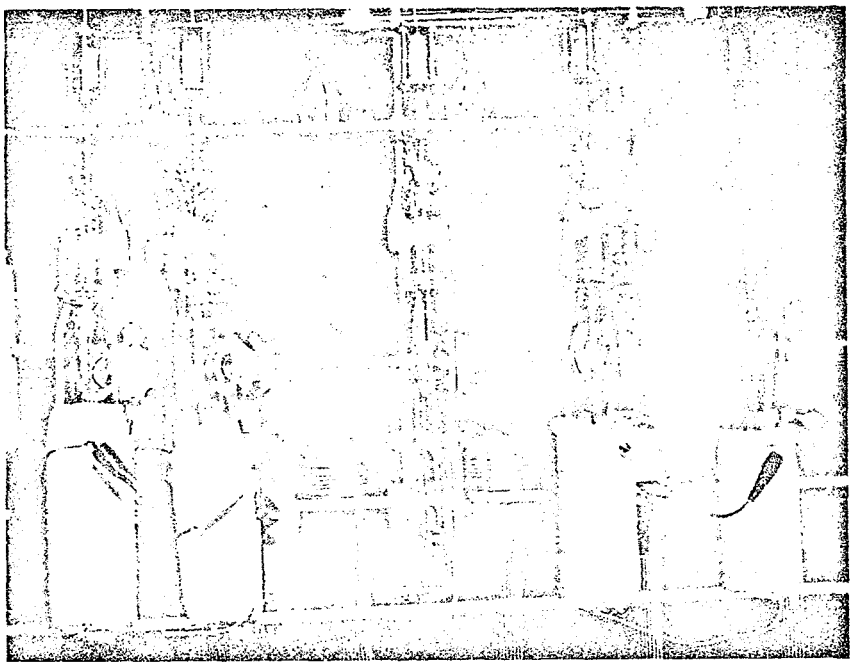
TEST CHAMBER AND LEAD CIRCUITRY

Figure 2

The measurement in vacuum of dissipation factor, insulation resistance and capacitance of the connector insert materials and potting compound samples was accomplished by the use of a special fixture (Figure 3 and4) designed and developed by ARDEL CORPORATION. Figure 3 shows five such fixtures in operation on the vacuum train. Figure4 is a detailed drawing which shows how the assembly functions. The fixture was designed so that the planar surfaces of the sample would see the vacuum environment when measurements were not being performed. To make measurements with the fixtures the top electrode is lowered to the sample surface and centered on the sample. The top electrode and sample guard ring assembly are further lowered to the bottom electrode which is centered on the lower surface of the sample. Then the entire assembly is lowered until the spring on which the bottom electrode is attached, is fully compressed. The capacitance, dissipation factor, and insulation resistance are then performed in that order using the appropriate instruments. The order of electrode movement is reversed after the measurements, thus again allowing the planar surface to see the vacuum environment.

All of the measurements obtained at atmospheric pressure were performed at room temperature (before and after vacuum). The measurements obtained in vacuum, were performed at the test temperature of the sample.

The samples tested in ultra high vacuum were weighed before and after exposure as above. The test chambers used were of similar design to the chambers shown in Figure 5.



ARDEL CAPACITANCE
MEASURING FIXTURES

Figure 3

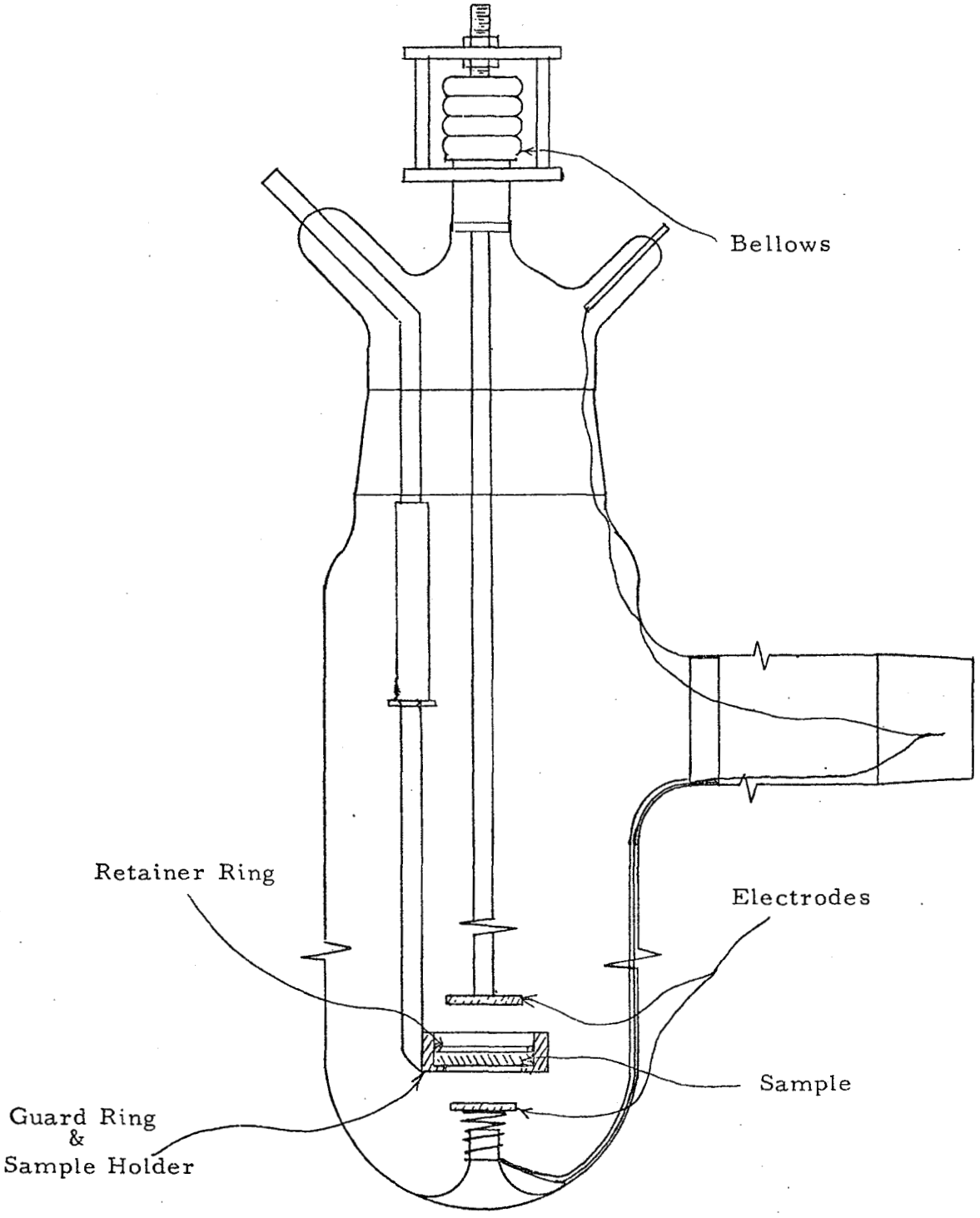


Figure 4

DIELECTRIC VACUUM TEST FIXTURE

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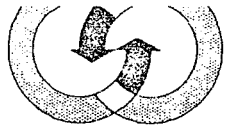

The condensible outgassed products when collected in the high vacuum tests (when present) wereobserved and recorded at the completion of each sample test. Condensible materials were collected at the room ambient emperature area of the sample chambers, and at the liquid nitrogen temperature area of the U-traps. Infrared spectrometric analysis was performed on the condensibles after their observation. In some instances there was not enough condensible material collected to allow for infrared analysis. When this happened a larger quantity of sample material was exposed to vacuum at 225°F, so that enough infrared sample could be collected for analysis. The infrared samples, which were liquid or semi-solid, were smeared on a sodium chloride cell or between two cells and inserted into the infrared instrument (Perkin-Elmer) for analysis. Those infrared samples, which were solid, were mulled separately with mineral oil and Fluorolube. The mulled samples were then individually smeared between two cells and analyzed using a Perkin Elmer Infracord, (Figure 6).

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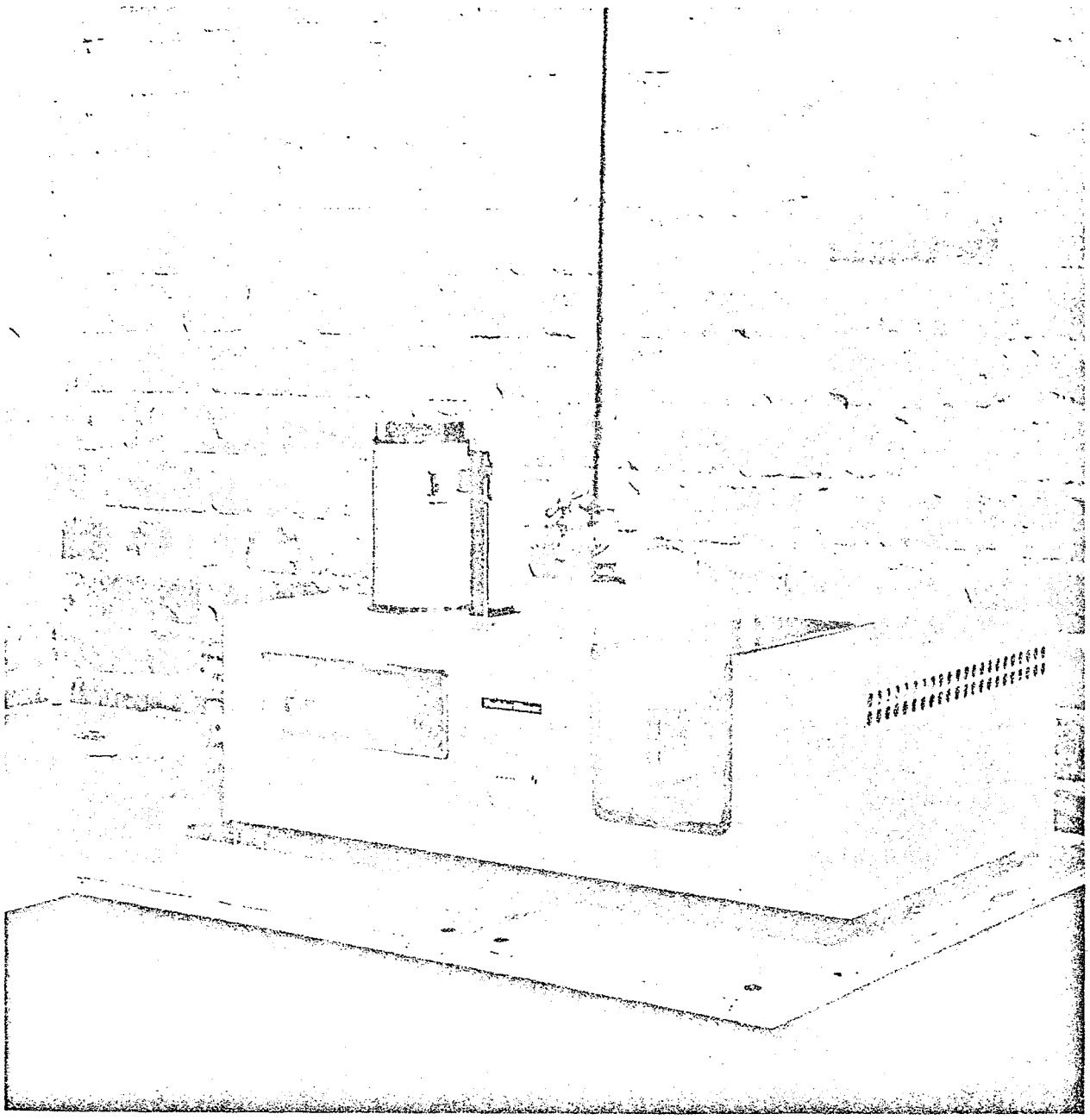
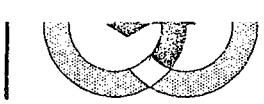


INFRARED SPECTROPHOTOMETER USED FOR
CHEMICAL ANALYSIS OF DEGRADATION PRODUCTS



RESULTS AND CONCLUSIONS

SAMPLE RATING

A table of results has been formulated which rates the samples in each of the test parameters relative to one another. The samples have been rated under four categories:

Negligible

Small

Moderate

Excessive

These terms apply to changes, which were positive or negative in any one of the following categories:

Weight Change

Capacitance Change

Insulation Resistance Change

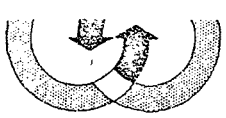
Dissipation Factor Change

Hardness Change

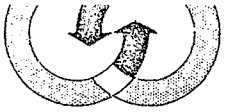
A. WEIGHT LOSS RATING

Almost every sample evaluated under this program has undergone a detectable weight change. Certain samples however have lost a most significant amount of weight and are therefore itemized below.

1g2	-6%	Phenolic, glass filled, connector insert, Fiberite Company
2g1	-4.1%	Polyurethane, "Adiprene Rubber-C", connector material, DuPont
2g2	-6.7%	"



4a3	-2.0%	Polyolefin, "Thermofit", sleeving, Ray therm Corp.
6a4	Melted	Polyurethane, "Durathane WGE 3, "jacketing, Whitmore Plastics
6c3	-4.3%	Mystick tape, jacketing, 3-M
8a2	-2.9%	Polyurethane, "793", potting compound, Coast Pro Seal.
8a12	-3.2%	Polyurethane, "PR 1527", potting compound, Products Research
8b1	-5.0%	Epoxy "1368", potting compound, Furane Plastics
8b2	-15.2%	"
8c2	-2%	Silicone, RTV 881, potting compound, Dow Chemical
8c33	-3%	Silicone, RTV 891, potting compound, Dow Corning
8c31	-3.2%	"
8c32	-4.2%	"
8c51	-4.9%	Silicone, 295-1, potting compound, Epoxylite Corp.
8c52	-3.6%	"
8d1	-2.7%	Polyester, "Selectron" potting compound, Pittsburgh Paint
8d2	-5.9%	"
7a4	-2%	Nylon, "Cab-L-Tite," Cable clamp, Dakota Engineering, Inc.
7b6	-2.2%	Nylon, "Ty-Rap", cable clamp, Thomas & Betts Corp.
7b4	-2.1%	"



1h2c	-4.8%	Silicone, "J.C." Series, connector insert, Cannon Electric
1h3c	-3.2%	"

Weight Loss Rating

0.00-0.1%	Negligible
0.1-0.5%	Small
0.5-1.0%	Moderate
1.0-(15%)	Excessive

B. CAPACITANCE CHANGE

Changes in capacitance were few and were rated according to the capacitance rating table below.

Capacitance Rating

0.-1 pf change	Negligible
1-2 pf change	Small
2-4 pf change	Moderate
5 or over change	Excessive

The summary table at the end of the Results section shows the samples rated as to whether a capacitance change occurred in vacuum or in air measured before and then after vacuum.

C. INSULATION RESISTANCE CHANGE

Samples are rated in the summary table according to the following rating:

Insulation Resistance Rating

0-10 ohm change	Negligible
10-50 ohm change	Small
50-100 ohm change	Moderate
100-1000 ohm change	Excessive

D. DISSIPATION FACTOR CHANGE

The samples were rated in the summary according to the following rating:

Dissipation Factor Rating

Less than .001-0.02	Negligible
0.02-0.05	Small
0.05-0.1	Moderate
0.1-1	Excessive

E. HARDNESS CHANGES

Certain of the samples which were exposed to vacuum at various temperatures experienced increases in hardness. These samples are rated in the summary table at the end of this section. Until a complete chemical history on each of these materials has been reviewed the final conclusion cannot be drawn as to the reasons for the increase in hardness. Sample number 1h4 displayed an excessive increase in hardness without detectable changes in weight loss or any of the electrical parameters. Such an increase

is probably due to vacuum curing of the material. Most of the other sample materials which experienced large increases in hardness correspondingly displayed significant weight losses. Hardness of the samples was rated according to the following table:

Hardness Rating	
0-2 Divisions	Negligible
2-4	Small
4-6	Moderate
6 or over	Excessive

Most of the samples preliminarily tested at ultra high vacuum (UHV) and 225°F did not show weight changes significantly different from the same materials samples tested at high vacuum (HV). The measurements of the dielectric and other parameters were therefore not warranted. However, one sample 1b6-Burndy connector insert, had a significant difference between UHV and HV weight change data. Thus the other parameters were measured and found to compare closely with the respective high vacuum measurements of the same parameters.

TABLE 2

Sample No.	Weight Change Before & After	Capacitance Change In Vacuum	Capacitance Change In Air	Insulation Resistance Change In Vacuum	Insulation Resistance Change In Air	Dissipation Factor Change In Vacuum	Dissipation Factor Change In Air	Hardness Change Before & After
1a4a***								
1a5								
1a3a								
1a1a								
1a2a								
1b4a								
1b5								
1b1a								
1b2a	-S							
1b3a	-S							
1c4								
1c5	-S							
1c1	-S							
1c3	-S							
1c2	-S							
1d4								
1d5	-S							
1d3	-S							
1d1	-M							
1d2	-M							
1e6								
1e1								
1e2								
1e5	-S							
1e3	-S							
1e15								
1e11								
1e14								
1e13	-S							
1e12	-S							
1e25	-S							
1e21								
1e23	-S							
1e22	-S							
1e24	-M							

TABLE 2 (cont.)

Sample No.	Weight Change Before & After	Capacitance Change In Vacuum	Capacitance Change In Air	Insulation Resistance Change In Vacuum	Insulation Resistance Change In Air	Dissipation Factor Change In Vacuum	Dissipation Factor Change In Air	Hardness Change Before & After
1e35								
1e31								
1e32								
1e33	-S							
1e34	-S							
1f6								
1f1								
1f2								
1f4								
1f3								
1g4								
1g5	-S							
1g3	-M							
1g1	-E		-S		+S			
1g2	-E				+M	+S	-S	
1h4								+E
1h5								+M
1h3a								
1h2a	-S							
1h1a	-S							
2a5								
2a4								
2a3								
2a2	-M							
2a1	-E							
2b4	-S							
2b5	-M							
2b3	-M							
2b2	-E							
2b1	-E							
2c6			-S					
2c1			-S					
2c2								
2c5								
2c3								

TABLE 2 (cont.)

Sample No.	Weight Change Before & After	Capacitance Change In Vacuum	Capacitance Change In Air	Insulation Resistance Change In Vacuum	Insulation Resistance Change In Air	Dissipation Factor Change In Vacuum	Dissipation Factor Change In Air	Hardness Change Before & After
2d5								
2d4	-S							
2d3	-S							+S
2d2	-S							
2d1	-S							+S
2e4							-S	+S
2e5								
2e3	-S						+S	
2e1	-M							+S
2e2	-E	+M	+M			+E	+E	+S
2f5	-S							+S
2f2	-S							+M
2f1	-E							+S
2f4	-E					+M		+S
2f3	-E	+E				+E		+E
2g4	-M				+M	-S		+S
2g5	-M			+S	+S		+S	+S
2g3	-E	+S		-E	+E	+E		+S
2g1	-E			+E	+M	-E		+S
2g2	-E	+M	+S	+M	+E	+E		
2h4								
2h5								
2h3	-S		+S					
2h1	-S			-M				-S
2h2	-S		+M					
4a4								
4a1					+S			
4a2	-S							
4a5	-E							
4a3	-E				+S			
4b4	-S							
4b1	-S				+S			
4b2	-S							
4b5	-S							
4b3	-M							
6a1								
6a2								
6a3	-S							

TABLE 2 (cont.)

Sample No.	Weight Change Before & After	Capacitance Change In Vacuum	Capacitance Change In Air	Insulation Resistance Change In Vacuum	Insulation Resistance Change In Air	Dissipation Factor Change In Vacuum	Dissipation Factor Change In Air	Hardness Change Before & After
6a4	Melted							
6c4	-S							
6c1	-S							
6c2	-M							
6c5	-E							
6c3	-E							
6d5								
6d1	-S							
6d2	-S							
6d4	-S							
6d3	-S							
8a4	-S							+S
8a5	-S				+S			+M
8a3	-M				+S			+S
8a1	-E			-S	+S			+M
8a2	-E		+S				-M	+E
8a14	-S							+E
8a15	-S				+S			+E
8a13	-M			-S	+M			+E
8a11	-E			-S			+E	+E
8a12	-E			+S			-M	+E
8b4	-S							
8b5	-S							
8b3	-M							
8b1	-E	+S		+S				
8b2	-E			+E				
8c4				+M				
8c5	-S							
8c3	-M							
8c1	-E				+S			
8c2	-E		+M		+S			
8c14	-S							
8c15	-S							
8c13	-M							
8c11	-M							
8c12	-E		+S		+M			

TABLE 2 (cont.)

Sample No.	Weight Change Before & After	Capacitance Change In Vacuum	Capacitance Change In Air	Insulation Resistance Change In Vacuum	Insulation Resistance Change In Air	Dissipation Factor Change In Vacuum	Dissipation Factor Change In Air	Hardness Change Before & After
8c24								+S
8c25	-S							+S
8c23	-S							+S
8c21	-E							+M
8c22	-E	+S					+M	+S
8c34	-S				-S			
8c35	-M							
8c33	-E							
8c31	-E	+S						
8c32	-E							
8c44								+S
8c45	-S							+S
8c43	-M							+S
8c41	-E							+S
8c42	-E	+S						+M
8c54	-S							+E
8c55	-S							+E
8c53	-M							+E
8c51	-E				+E		-M	+E
8c52	-E			+M	+S			+M
8c64								+M
8c65	-S							+M
8c63	-M							+S
8c61	-E				+S			+M
8c62	-E				+S	+M		+M
8d4								
8d5	-S							
8d3	-M							
8d1	-E							
8d2	-E			+S				
8f4								+E
8f5								+M
8f3								+M
8f1								+M
8f2	-S							+M

TABLE 2 (cont.)

Sample No.	Weight Change Before & After	Capacitance Change In Vacuum	Capacitance Change In Air	Insulation Resistance Change In Vacuum	Insulation Resistance Change In Air	Dissipation Factor Change In Vacuum	Dissipation Factor Change In Air	Hardness Change Before & After
8f14								
8f15								
8f13	-S							
8f11	-S					+S		
8f12								
6b1								
6b2								
6b3								
6b5	-S							
6b4	-S							
5a5	-S							
5a2	-S							
5a3	-E							
5a1	-E							
5a4	-E							
7a1	-S							
7a2	-S							
7a3	-E							
7a5	-E							
7a4	-E							
7b1								
7b2	-S							
7b3	-E							
7b6	-E							
7b4	-E							
7c5								
7c2	-S							
7c3	-M							
7c4	-M							
7c1	-E							
1a1b*								
1b2c°	-S							
1a2d**	-S							
1a3c	-S							
1a3d								
1a4d								
1b1d	-S							

TABLE 2 (cont.)

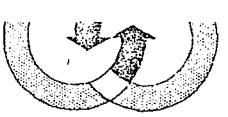
Sample No.	Weight Change Before & After
1b2d	-S
1b3d	-M
1b4d	
1h1b	-S
1h2b	
1h2c	-E
1h3b	
1h3c	-E
1a6	-S
1b6	-E
1c6	-S
1e16	-M
1f7	-S
1h6	-S
2a7	-S
2c7	
2d7	-S
2h7	-S
4b7	-M
6b7	-M
6d6	-S
8f6	
8f16	

*** a Connector insert proper

* b Connector insert metal body

° c Connector insert rubber retainer ring

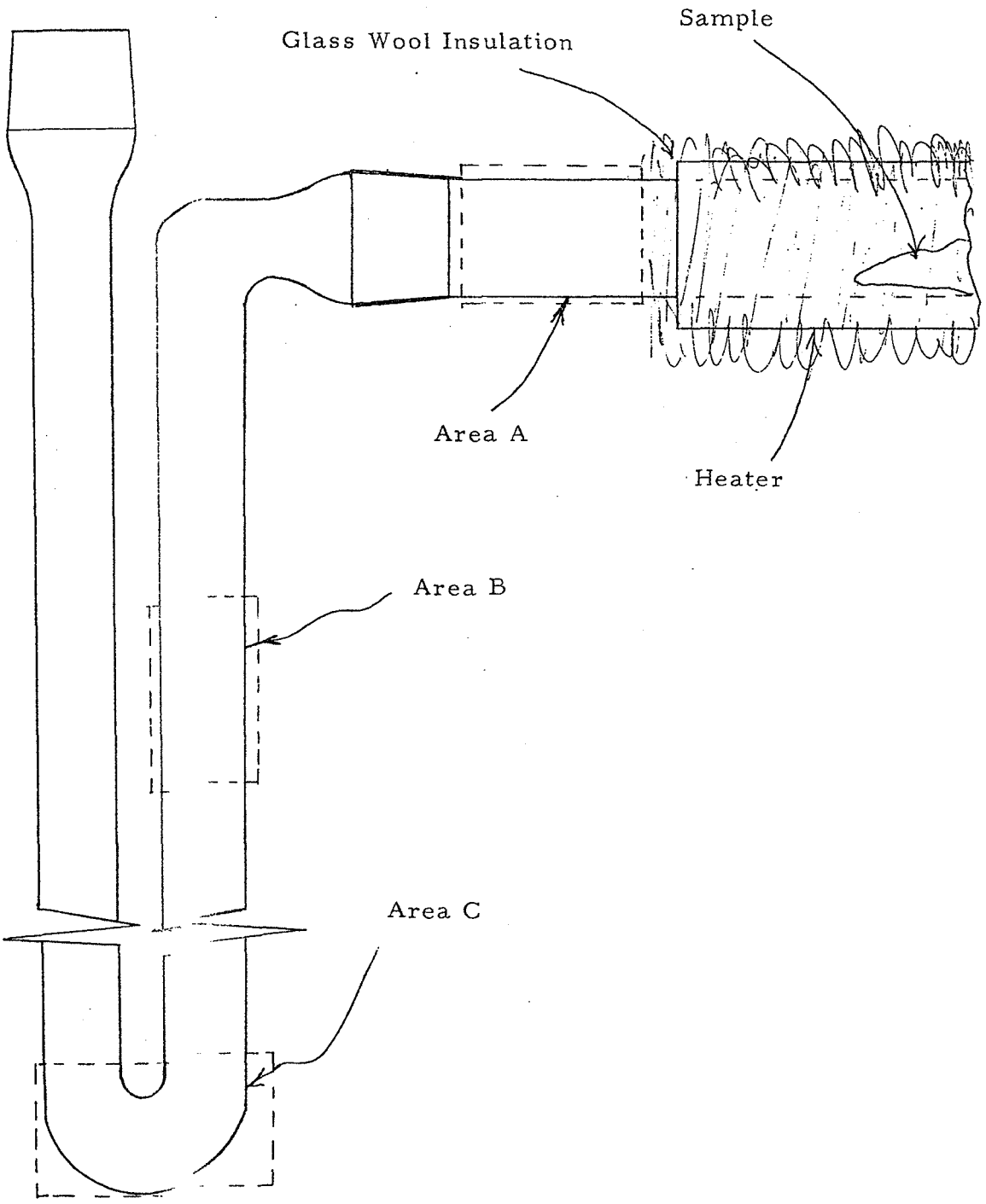
** d Connector insert proper pieces



CONDENSIBLE ANALYSIS

The condensible outgassing products of the samples tested at high vacuum were observed visually for light transmittance of the condensed films and for the character of the outgassing products at the termination of the tests. After visual observation was made, infrared analysis was performed on the samples with sufficient condensibles. Table 10 below lists the sample transmittances of the condensates collected at the room temperature and liquid nitrogen temperature areas. These headings on the table are abreviated respectively RmT. and LN_2. The data in the table represent the film transmittance after the liquid nitrogen U-trap had reached room temperature. The transmittance at liquid nitrogen temperature was not used as data since this temperature is not a representative operational temperature for an optical path condensible surface. This surface will most likely see a temperature cycle, which would probably vary from liquid nitrogen temperature (-325°F) to somewhat higher than 78°F (room temperature). Therefore, room ambient temperature was selected as the U trap temperature when the transmittance and character of the condensibles were observed for record.

The deposited outgassing products were collected primarily in three areas, which are represented by A, B, and C in Figure 7 . Area A represents the room temperature surface of the test chamber adjacent to the heated portion Thus , surface A collected the outgassing products, which had a more reduced vapor pressure at room temperature than at the test temperature. Area B is the surface where the remaining outgassing products experience liquid nitrogen temperature and here the majority of these



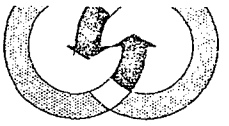
TEST CHAMBER & U-TRAP

Figure 7

condensibles collected. Area C, shown in Figure 7 , represents the bottom of the U-trap and where the remainder of the condensibles deposited. Area C is not represented in Table 10 because only a few samples had condensates collected there.

Examining Table 10 shows that no condensibles were collected for the -100°F samples. Several materials in the table have condensate film transmittances of the two areas which appear to be out of sequence and thus warrent an explanation. At first thought one would assume more condensate to be deposited at the -325 °F and thus less transmittance. The materials: Thermofit (4a) and Mylar tubing (4b) tested at 225°F and 300°F had given off a less transparent film at the room temperature area than at the liquid temperature area. This is understood when condensate temperature and vapor pressure are compared, and also the knowledge that the transmittance of the condensate is more dependent on the material condensed rather than the amount. Low vapor pressure (high boiling point) materials condense at higher temperatures than high vapor pressure (low boiling point) compounds. Therefore, the less transparent material collected at the room temperature area has an appreciably lower vapor pressure than the material deposited at the liquid nitrogen temperature area. The condensate of Area B was a material with a high transmittance and the Area A material was a low transmittance substance. The above explanation holds true also for the materials: Dakota clamps (7a) and Thomas and Betts clamp (7b), which also had less transparent film at room temperature area than at Area B.

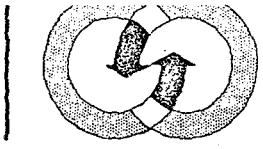
The Bendix silicone connector insert material (1a) gave off very little condensible outgassing products for all temperatures tested. No infrared



analysis was performed due to a lack of sufficient condensate. A trace of carbon dioxide was indicated in the U-traps of some of the tests. Carbon dioxide was assumed because as the U-traps warmed to room temperature the slight amount of white solid sublimed rather than melted. Whenever carbon dioxide is assumed to be present in the following U-traps of the sample tests, the above observed phenomena is the reason for the assumption.

The Burndy silicone connector insert material samples (1 b) produced small amounts of condensibles, and enough to perform infrared analysis for the samples tested at 225°F and 300°F. Trace amounts of carbon dioxide outgassed from the samples tested at room ambient and above temperatures; also small amounts of colorless liquid were collected at the liquid nitrogen temperature areas for these samples. The spectral interpretations of the outgassing products of the samples are given below. Spectra Research Laboratory performed the spectral interpretations of the infrared spectrographs.

The condensate numbers, given in the tabulated data below, represent the ARDEL CORPORATION sample number, the sample material, the test temperature, and the condensate area. For example: 307-1-1b-225-A, the 307-1 is the ARDEL sample number, 1b represents the material number, the 225 designates the test temperature of 225°F, and the A is the area from which the condensibles were taken for spectra analysis. The last digit (A etc.) of some of the condensate numbers is sub-numbered in a few cases to designate between two distinct and separate condensates collected at the same area.



Identical spectra and spectral interpretations were obtained for several condensibles of different materials. The typical spectra for these condensates is shown in the appendix. The last digit of the condensate number is underlined to signify the condensate spectrum which was chosen as being typical. For brevity the spectral interpretations, which were identical for several condensates, are grouped together.

Condensate No.	Material tested	Spectral Interpretations
307-1-1b-225-A	Burndy Silicone connector insert	This sample is loaded with a siloxane. A strong carbon-hydrogen (3.3-3.4 microns) with a weak carbonyl at 5.85. A good methylene rock near 14 microns. An aromatic material is indicated at 14.3 microns.
307-1-1b-300-A	" "	This sample is loaded with a siloxane. It has a carbonyl at 5.8 microns.
307-1-1b-300-B	" "	It has a silicone, also a weak carbonyl at 5.85 microns. There is no apparent hydroxyl band.
307-1-1h-225-A	Cannon Electric Silicone connector insert	As above
307-1-6b-225 A	Bentley-Harris Silicone	As above
307-1-6b-225-B_1	Sleeving	As above
307-1-7c-225-C	T.A. Silicone cable clamp	As above
307-1-8cIII-225-A	G E RTV-88 potting compound.	As above
307-1-8cIII-225-C	"	As above
307-1-8cV-225 A	Dow Corning DC-501	As above
307-1-8cV-225-B	"	As above

The Deutsch silicone connector insert produced very small amounts of condensibles from all temperature tests. Trace amounts of carbon dioxide and water were collected at Area B of the samples tested at room temperature and above. A clear yellow liquid collected at Area A of the 225°F test and an infrared spectral analysis was performed on it.

The Bendix viton connector insert outgassed very little condensibles for all the tests. No infrared spectral analysis was obtained because of this. Carbon dioxide was assumed to have collected at the liquid nitrogen temperature area, but because of the water also present a spectrum could not be obtained to confirm this assumption.

307-1-1c-225-A	Deutsch Silicone connector insert	At 2.87 microns is a very weak hydroxy group. Carbon-hydrogen at 3.3-3.4 microns (low), carbonyl is seen (ester most likely). A broad band at 7.8-7.9 microns. This is not a perfect fit for a silicone of the siloxane type. The rest of the spectrum would fit the description.
307-1-1h-150-A	Cannon Electric silicone connector insert	As above

The four types of diallyl phthalate connector inserts from Mesa Plastics produced only a slight amount of condensate at liquid nitrogen temperature areas of all of the test samples. The condensates above were presumed to be water and carbon dioxide. No spectrum was obtained for these samples.

Mesa Plastics epoxy connector insert samples had the same results as above.

The phenolic connector insert from Fiberite outgassed appreciably at 225°F and 300°F. The outgassing products were water and ammonia. The

ammonia was evident from the very strong smell in the U-trap. An attempt was made to run a spectrum but the water partially dissolved the NaCl cells, and thus ruined the spectrum.

The Cannon Electric silicone connector insert produced noticeable condensate for all the samples, except -100°F test. A colorless liquid was collected at the liquid nitrogen temperature area of the samples. The spectral analyses of the condensates are listed below.

307-1-1h-150-A	Cannon Electric silicone connector insert	See 307-1-1c-225-A
307-1-1h-150-B	"	This has a small hydroxy band. A lot of carbon-hydrogen (may be aliphatic in nature) is seen. A carbonyl at 5.83 microns (acid). A lot of detail from 6 to 7 microns is indicative of aromatic material, also by bands at 12.5-14.5 microns. There is a very slight trace of silicone (7.97 microns).
307-1-1h-225-A	Cannon Electric silicone connector insert	This most likely is a phenyl silicone. There is a lot of detail between 6-7 microns and this is very typical of silicone spectra with some hydroxyl at 3.0 microns.
307-1-1h-225-B	"	It is loaded with silicones. It has carbonyl at 5.8 microns. It has carbon-hydrogen.
307-1-7c-225-A	T. A. Silicate rubber cable clamp	As Above
307-1-8cI-225-C	"	As Above
307-1-8cII-225-B	"	As Above
307-1-8cVII-225-B	"	As Above
307-1-8cVII-225-C	"	As Above

Koppers' Rexolite produced condensible outgassing products only for the 225°F and 300°F test samples at the liquid nitrogen temperature area. The spectral analysis is below.

307-1-2a-225-B	Koppers Rexolite connector compound	Has carbonyl (acid) free. Some small hands 6-7 microns are indicative of an aromatic material. At 14 microns there may be an aromatic carboxylic acid in the material.
307-1-6c-225-C	3M Mystick tape jacketing	As Above

DuPont's "SP" and "ML" connector compound gave off condensibles for the 150°F, 225°F and 300°F tests. None of the condensates collected were sufficient for spectral analysis.

The 3M Kel-F connector compound gave off no apparent condensible materials. Thus no spectral analysis was obtained for these materials.

The DuPont mylar produced only slight amounts of condensate at the liquid nitrogen temperature area of the samples tested at 225°F and 300°F. The 300°F sample produced a white translucent solid, but not enough for spectral analysis.

DuPont's "Hypalon" rubber produced condensibles at the room and liquid nitrogen temperature areas of the 150°, 225° and 300°F samples. An amber colored liquid was collected from the three samples. The 225°F and 300°F sample chambers contained a strong smell of sulfur dioxide or sulfur trioxide after test. A small amount of crystalline material was observed at the bottom of the U-trap and also on the 225°F sample surface. The spectral analysis of the condensate from the 225° and 300°F samples are shown below.

307-1-2s-225-A	DuPont "Hypalon" rubber connector compound	This looks like a hydrocarbon ester mixture with a trace of silicone in the material.
307-1-2s-225-B	"	A complex aromatic material with a hindred phenol. A carbonyl band at 5.8 to 6.9 microns. Also may be an amide I Type (carbonyl), (mostely aromatic).
307-1-2s-300-B	"	As Above

The DuPont "Neoprene" rubber produced a white translucent solid which colledted at the liquid nitrogen temperature area of the room, 150°F, 225°F and 300°F test samples. More of the white solid appeared to have collected from the 150°F sample than the 225°F and 300°F samples. The most probable explanation of this is that at the high temperature (225°F and 300°F) the rubber was post curing. The curing caused polymerization and thus less "volatiles" were present for the 225° and 300°F test samples than for the 150°F and 75°F samples which did not polymerize appreciably. The spectral analysis of the condensates from the 150°F, 225°F and 300°F samples are shown below.

307-1-2f-150-B	DuPont "Neoprene" rubber connector compound.	An aromatic carbonyl is indicated at 6.25 microns and an aromatic material is shown in 12.5-13.0 micron region.
307-1-2f-150-B	"	As Above
307-1-2f-225-A	"	Good sharp hydroxyl at 2.9 microns (may be a tertiary hydroxyl or hindered). It has a methylene group. Carbonyl at 5.8 microns, 6-7 region and 12.6-12.95 microns indicate aromatic structure.
307-1-2f-225-B	"	As Above

The DuPont "Adiprene" rubber outgassed condensible products, which collected at Area B of all of the elevated temperature test and also

the room temperature test. Monoclinic crygstals formed at the liquid nitrogen temperature area of the 150°F test. The 225°F test produced a green liquid which collected at Area C of the U-trap. This was the only sample in which a green condensate was noted. The spectral analysis of the condensates from the 150°F, 225°F and 300°F samples are listed below.

307-1-2g-150-A	DuPont "Adiprene" rubber connector compound.	A strong carbon-hydrogen (3.3-3.4 microns) with a weak carbonyl at 5.85 (acid but no hydroxyl). Also no amine is present. It could have some aromatic materials in the sample. No ethers (poly glycols).
307-1-2g-225-A	"	As Above
307-1-2g-225-B	"	A hindered hydroxyl group (2.9) or secondary or tertiary amine. Weak complex carbon hydrogen bands at 5.1-5.2 microns could be a double bond structure. Carbonyl at 5.88 (may be an acid). There are a lot of bands between 6-7 microns and strong bands in 12.5-14.3 microns range (aromatic material most likely bulk of material).
307-1-2g-225-B_2	"	As Above
307-1-2g-300-C	"	As Above
307-1-2g-300-B	"	An odd band at 2.9 to 3.3 microns could be some nitrogen base. A carbonyl at 5.5 may indicate an unusual structure. There are a lot of fine structure in 6-7 micron region with a band at 13.3, which would indicate aromatic materials.

The DuPont "Viton" rubber connector compound outgassed only slight amounts of colorless condensibles, which collected at liquid nitrogen

temperature areas of the 150°F, 225°F and 300°F samples. Also trace amounts of carbon dioxide apparently collected at these areas from the samples. No spectral analyses were obtained because of insufficient amounts of condensibles.

307-1-4a-225-A	RayChem"Thermo-fit" sleeving	This looks like an olefin with a carbonyl group. (May be a mixture), because of the broad nature of the carbonyl, it is mostly acid carbonyl. The hydroxyl band at 3.1 microns supports this.
307-1-4a-225-B	"	As Above
307-1-4a-300-A	"	This looks like an olefin with a carbonyl group. (May be a mixture, because of the carbonyl, is mostly acid carbonyl). A slight hydroxyl band would confirm this (3.05 microns).
307-1-4a-300-B	"	This spectrum looks like a more complex mixture of the same general nature as above. a much broader carbonyl band is evident.
307-1-4a-300-B	"	It could have some amine in the 3 micron region.

The mylar tubing of Stone Paper Tube Company outgassed noticeable condensates only for the 225°F and 300°F tests. Deposition was mainly at the room temperature areas. A sweet perfume odor, similar to the musk odor, was noted in the 225°F U-trap. The spectral analysis of the 225°F test is listed below.

307-1-4b-225-A	Stone Paper Mylar tube sleeving	This has a medium strength hydroxy group (2.95 microns). A well defined carbon-hydrogen at 3.4 to 3.5 microns, and a strong carbonyl (most likely a free acid). A little structure is evident at 6-7 microns and also at 12.7-14.1 microns (a 1-4 aromatic). It has some ether. It may be a poly glycol or related material.

The Ply-O-Seal nylon potting cups produced considerable water which collected at the liquid nitrogen temperature area for all the samples tested. The spectral analyses of the condensates are listed below.

307-1-5a-225-A	Ply-O-Seal Nylon potting cups.	Amine and amide I. A nitrogen base. It may be a low molecular weight polymer or monomer.
307-1-7a-225-A	Dakota Nylon cable clamps	As Above
307-1-7b-225-A	Thomas & Betts Nylon cable clamps	As Above
307-1-7b-300-A	"	As Above
307-1-5a-300-A	Ply-O-Seal Nylon	At 2.95 microns a sharp hydroxyl band, or it could be an amine secondary. At 6.1 microns an amide

307-1-5a-300-A	Ply-O-Seal cont.	appears. No carbonyl band from an adipic acid fragment. It may be a low molecular weight polyamide.
307-1-7a-300-A	Dakota nylon cable clamps	As Above
307-1-7b-300-A	Thomas & Betts nylon cable clamps	As Above

Whitmore's Durathane completely melted at 300°F; it produced considerable condensate for all tests except the -100°F test. Ten spectra were obtained from condensates of this material; their spectral interpretations are listed below.

307-1-6a-75-B	Whitmore Durathane jacketing.	There is evident a broad hydroxy band and a good carbon-hydrogen stretching band. The carbonyl band (5.73 microns) could be an ester. There isn't any aromatic structure in this spectrum. No spectra of any free isocyanates.
307-1-6a-225-B	"	As Above
307-1-6a-150-B	"	An aliphatic carbon-hydrogen with an ester. No spectra of any free isocyanates.
307-1-6a-300-A_1	"	As Above
307-1-6a-300-B_1	"	As Above
307-1-6a-225-A	"	There might be a part of a toluene diisocyanate molecule that has decomposed. At 8.0-8.5 microns there is an unusual type of band. It could be due to a chain fragment. No spectra of any free isocyanates.
307-1-6a-225-B	"	This has a very broad hydroxyl band and carbonyl band. It may be a free acid. No spectra of any free isocyanates.

307-1-6a-300-A2	Whitmore Durathane cont.	Mostly ester with a lot of small detail. No spectra of any free isocyanates.
307-1-6a-300-B2	"	The only thing evident is an ester and some other carbonyl. No spectra of any free isocyanates.

The Bentley-Harris silicone fiberglass jacketing gave off a clear liquid and white solid, which collected at the liquid nitrogen temperature areas of the elevated temperature tests. A colorless liquid collected at room temperature areas of the 225°F and 300°F tests. The spectral analyses of the above mentioned condensates are listed below.

307-1-6b-150-B	Bentley-Harris silicone fiberglass jacketing	It has a silicone in the material. There is evident a broad hydroxyl band and a good carbon-hydrogen stretching band. The carbonyl band (5.73 microns) could be an ester.
307-1-6b-300-B	"	As Above
307-1-6b-225-A	"	See 307-1-1b-300-B
307-1-6b-225-B1	"	See 307-1-1b-300-B
307-1-6b-225-B2	"	It is loaded with silicones. It has two different kinds of carbonyl (ester and acid).
307-1-7c-225-B	T. A. Silicone cable clamps.	As Above

The 3 M's mystick tape outgassed condensible white solid material which collected in the liquid nitrogen temperature area of the room temperature and 150°F samples. For both the 225°F and 300°F tests there was a colorless liquid and solid collected at Area A. The relative amounts of condensate collected at Area B for the room and elevated temperature tests were greater the lower the test temperature, until for the 300°F test no

detectable condensibles were observed. The reason for the larger amounts at the lower temperature is most probably post curing and thus increased polymerization at the higher temperature. Therefore, at 225°F and 300°F there were less volatiles to outgas. The spectral analyses of the condensates are listed below.

307-1-6c-75-B	3M mystick tape jacketing	Very little or no carbon-hydrogen. doublet at 5.8 and 6.65 microns look like vinyl type of complex ester structure.
307-1-6c-150-B	"	As Above
307-1-6c-225-A	"	It appears to be some silicone material. A sharp peak at 7.95 microns. A broad band between 9-10 microns. The only thing that doesn't fit well is the band between 11-12 microns.
307-1-6c-300-A	"	As Above
307-1-6c-225-B	"	Very small ill-defined carbon-hydrogen band. A lot of different kinds of esters (5.6-5.9 microns). May have an aromatic material (14 microns).
307-1-6c-225-C	"	Has carbonyl (acid) free. Some small bands 6-7 microns indicative of aromatic material. At 14 microns there may be an aromatic carboxylic acid in the material.

National Metalizing's aluminized mylar jacketing outgassed very slight amounts of condensibles.

The Dakota nylon cable clamps and Thomas and Betts nylon cable clamps outgassing products explanation is identical to the Ply-O-Seal discussion above. The spectral analyses of these materials are listed above.

The T. A. Silicone cable clamps outgassed three different types of condensibles. A clear liquid was collected at the room temperature area of the tests. The liquid nitrogen temperature areas B & C yielded a white gelatinous material at B and a yellow liquid at Area C. The spectral analysis of the condensates are listed below.

307-1-7c-75-A	T. A. Silicone cable clamps.	It is a siloxane material.
307-1-7c-150-A	"	As Above
307-1-7c-225-A	"	See 307-1-1h-225-B
307-1-7c-225-B	"	See 307-1-6b-225-B2
307-1-7c-225-C	"	As Above
307-1-7c-300-A	"	It is loaded with silicones and has a strong carbon-hydrogen band at 3.3 microns.

The Coast Pro-Seal potting compound produced a light yellow liquid condensate which collected at the three collection areas for the 225°F sample. The spectral analyses of the condensates are listed below.

307-1-8aI-225-A	Coast Pro Seal potting compound	Poly glycol (Hydroxyl at 2.95 microns and carbon-oxygen-carbon at 8.95 microns.
307-1-8aI-225-B	"	As Above
307-1-8aI-225-C	"	As Above

The potting compound PR 1527 of Products Research outgassed a colorless liquid and white solid at room temperature area and liquid temperature area respectively for the 225°F and 300°F test samples. The spectral analyses are listed below.

307-1-8aII-225-A	Products Research PR 1527 Potting Compound.	May be an ester. A check for nitrogen would be good. May be also a poly glycol ether.
307-1-8aII-225-B	"	As Above
307-1-8aII-300-B	"	As Above

The Furane Plastics potting compound gave off a colorless liquid condensate which collected at Area B of the 225°F and 300°F tests. The infrared analyses are listed below.

307-1-8b-225-B	Furane Plastics potting compound	This has a weak hydroxyl (2.9 microns) and a strong carbon-hydrogen (3.4 microns). It may be some ester or acid type carbonyl. It is aromatic, probably a di-substituted one. May have some carbon-oxygen carbon bands.
307-1-8b-300-B	"	As Above

The Dow Corning, RTV-881 potting compound outgassed a colorless liquid, which collected all three condensate areas, and plus a white solid at the liquid nitrogen temperature area. The spectral analyses of the condensates are tabulated below.

307-1-8cI-225-A	Dow Corning, RTV 881, potting compound	It has a silicone. Also an ester carbonyl. There is no apparent hydroxyl band.
307-1-8cVII-225-A	General Electric RTV-60, potting compound	As Above
307-1-8cI-225-B	Dow Corning, RTV 881, potting compound	This has what could be called methoxy group somewhere in the complex. Carbonyl at 5.83 microns with some (not large amount) of an aromatic material. Some silica-oxygen present. This spectrum is not loaded with silicones.

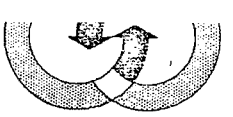
307-1-8cI-225-C Dow Corning cont. See 307-1-1h-225-B

The Products Research, PR 1930 compound outgassed a colorless liquid, which collected at all three condensate areas (A, B, and C) for the 225°F test. The spectral analyses, which were identical are shown below.

307-1-8cII-225-A	General Electric RTV-88	See 307-1-1b-300-B
307-1-8cII-225-B	"	As Above
307-1-8cII-225-C	"	As Above

The General Electric RTV-88 gave off white and colorless liquids, which condensed at the room and liquid nitrogen temperature areas, also a colorless liquid was collected at Area C of the 225°F test. The infrared analyses of these condensates are listed below.

307-1-8cIII-225-A	General Electric RTV 88, potting compound	See 307-1-1b-300-B
307-1-8cIII-225-C	"	As Above
307-1-8cIII-225-B	"	It has a silicone in the material. Also an acid type carbonyl at 5.85 microns.



The RTV-891 of Dow Corning outgassed colorless and also a clear light yellow liquid at the room and bottom of the liquid nitrogen temperature areas respectively. The spectral analyses are below.

307 1 8c IV-225-A	Dow Corning, RTV	It has a hydroxyl band at 2.85 microns. A carbonyl at 5.8 which may be an ester. It may have some aromatic material. The 7-9 micron region could be a carbon-oxygen-carbon type of structure.
307-1-8cVI-225-A	Epoxylite 205-1 potting compound	As Above
307-1-8cIV-225-C	Dow Corning, RTV 891, potting compound.	This sample is loaded with a siloxane. It has a hydroxyl at 2.9 microns and a carbonyl at 5.8 microns, (probably an acid). Sharp band at 6.6 microns.

The Dow Corning DC 501 gave-off three different appearing condensates at the three condensate areas. A colorless liquid at Area A, a white semi solid at Area B and a colorless semi solid at Area C were collected. The spectral analysis of the three condensates are listed below.

307-1-8cV-225-A	Dow Corning DC501 potting compound	See 307-1-1b-300-B
307-1-8cV-225-B	"	See 307-1-8cI-225-B
307 1-8cV-225-C	"	See 307-1-1b-300-B

The Epoxylite 295 1 potting compound produced colorless liquids, which collected respectively at room and liquid nitrogen temperature areas, and also a clear light red liquid which condensed at Area C. An ester odor was observed in the U-trap of the 225°F sample. The spectral analyses are listed below.

307-1 8cVI-225-A	Epoxylite, 295-1 potting compounds	See 307-1-8c-IV-225-A
307-1-8cVI-225-B	"	As above

307-1-8cVI-225-C	"	As above

The General Electric RTV-60 outgassed three condensates, which appeared dissimilar. A clear light yellow liquid collected at the room temperature area and a colorless liquid deposited at Area C. A colorless semi-solid collected at Area B. The spectral analyses of the condensates are given below.

307-1-8cVII-225-A	G.E., RTV-60 potting compound	See 307-1-8cI-225-A
307-1-8cVII-225-B	"	See 307-1 1h-225-B
307-1-8cVII-225-C	"	As above

The Pittsburgh Paint "Selectron" potting compound also gave off four dissimilar appearing condensates at the three condensate areas. The condensibles at area A, B and C were a clear brown liquid, a cream colored viscous liquid, and a colorless liquid and a clear yellow liquid respectively for the 225°F sample. An odor of accetic acid and styrene was detected in the U-trap after test. The spectral analyses of the collected condensates are tabulated below.

307 1-8d-225-A	Pittsburgh Paint "Selectron" potting compound	A good hydroxyl at 2.75 microns. A low carbon-hydrogen at 3.35 microns. An ester carbonyl.
307-1-8d-225-B	"	As above
307-1 8d 225-C	"	As above
307-1-8d-225-B2	"	A smear out at 3-4 microns region. At 5.38-5.6 micron region there appears to be an anhydride material with a lot of ester. May also have an aromatic mtl. A good strong carbon-

		oxygen-carbon at 7.8 microns (centered).
307-1-8d-300-B	"	As above.

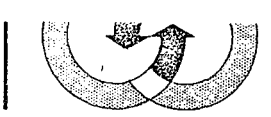
The Allied Chemical, "Aclar", potting compound outgassed only a slight amount, which condensed at the liquid nitrogen temperature areas of the tests. No spectral analyses were obtained for this material.

The Pensalt Chemical, "Kynar", produced a white solid and a clear light yellow liquid, which collected at the A and B areas respectively. The spectral analyses of the condensates are shown below.

307-1-8fII-225-A	Pensalt Chemical "Kynar" Potting compound	A small carbonyl band at 5.85. Some fluor-carbon. A good methylene rock near 14 microns.
307-1 8fII-225-B	"	A sharp carbon-hydrogen (may be mostly methylene groups. An ester type carbonyl. Some carbon-fluorine is present. In both spectra the two bands between 11-12 microns resemble a cyclic structure like cyclohexane.

CONNECTOR INSERT COMPONENT PARTS TESTING

The Bendix, Burndy and Cannon Electric connector insert samples were separated into their several parts, such as connector insert proper, metal body, rubber retainer ring and connector insert pieces. The insert proper consisted only of the basic material and pins; the connector pieces are the peripheral part of the insert proper which contained the adhesive. Testing the connector inserts in this manner permitted the determination of weight losses for the separated parts. Thus, the component part (if any) adversely affected by vacuum and thermal environment was noted; see the Weight Stability Table 5.



APPENDIX A

TABULATED DATA

Table 3

DISSIPATION FACTOR

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

General Radio, Type 1650-A Impedance Bridge was used to obtain the following data.

Sample No.	Dissipation Factor Before Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
1a4	0.001	0.001	0.001	0.001	0.001	-100
1a5	"	"	"	"	"	75
1a3	"	"	"	"	"	150
1a1	"	"	"	"	"	225
1a2	"	"	"	"	"	300
1b4	"	"	"	"	"	-100
1b5	"	"	"	"	"	75
1b1	"	"	"	"	"	150
1b2	"	"	"	"	"	225
1b3	"	"	"	"	"	300
1c4	"	"	"	"	"	-100
1c5	"	"	"	"	"	75
1c1	"	"	"	"	"	150
1c3	"	"	"	"	"	225
1c2	"	"	"	"	"	300
1d4	"	"	"	"	"	-100
1d5	"	"	"	"	"	75
1d3	"	"	"	"	"	150
1d1	"	"	"	"	"	225
1d2	"	"	"	"	"	300
1e6	"	"	"	"	"	-100
1e1	"	"	"	"	"	75
1e2	"	"	"	"	"	150
1e5	"	"	"	"	"	225
1e3	"	"	"	"	"	300
1e15	"	"	"	"	"	-100
1e11	"	"	"	"	"	75
1e14	"	"	"	"	"	150
1e13	"	"	"	"	"	225
1e12	"	"	"	"	"	300
1e25	"	"	"	"	"	-100
1e21	"	"	"	"	"	75
1e23	"	"	"	"	"	150
1e22	"	"	"	"	"	225
1e24	"	"	"	"	"	300

Table 3 (cont.)

DISSIPATION FACTOR

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Dissipation Factor: Before Exposure	In Vacuo: 1st day	In Vacuo: 4th day	In Vacuo: 7th day	After Exposure	Temp. °F
1e35	0.001	0.001	0.001	0.001	0.001	-100
1e31	"	"	"	"	"	75
1e32	"	"	"	"	"	150
1e33	"	"	"	"	"	225
1e34	"	"	"	"	"	300
1f6	"	"	"	"	"	-100
1f1	"	"	"	"	"	75
1f2	"	"	"	"	"	150
1f4	"	"	"	"	"	225
1f3	"	"	"	"	"	300
1g4	"	"	"	"	"	-100
1g5	"	"	"	"	"	75
1g3	"	"	"	"	"	150
1g1	"	"	"	"	"	225
1g2	0.03	"	0.004	0.01	"	300
1h4	0.001	"	0.001	0.001	"	-100
1h5	"	"	"	"	"	75
1h3	"	"	"	"	"	150
1h2	"	"	"	"	"	225
1h1	"	"	"	"	"	300
2a5	"	"	"	"	"	-100
2a4	"	"	"	"	"	75
2a3	"	"	"	"	"	150
2a2	"	"	"	"	"	225
2a1	"	"	"	"	"	300
2b4	"	"	"	"	"	-100
2b5	"	"	"	"	"	75
2b3	"	"	"	"	"	150
2b2	"	"	"	"	"	225
2b1	"	"	"	"	"	300
2c6	"	"	"	"	"	-100
2c1	"	"	"	"	"	75
2c2	"	"	"	"	"	150
2c5	"	"	"	"	"	225
2c3	"	"	"	"	"	300
2d5	"	"	"	"	"	-100
2d4	"	"	"	"	"	75
2d3	"	"	"	"	"	150

Table 3 (cont.)

DISSIPATION FACTOR

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Dissipation Factor Before Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
2d2	0.001	0.001	0.001	0.001	0.001	225
2d1	"	"	"	"	"	300
2e4	0.05	"	"	"	"	-100
2e5	0.025	0.025	0.025	0.025	0.025	75
2e3	0.03	0.05	0.05	0.05	0.05	150
2e1	0.05	0.05	0.05	0.05	0.05	225
2e2	0.06	0.2	0.6	0.8	0.8	300
2f5	0.001	0.09	0.10	0.10	0.001	-100
2f2	0.001	0.001	0.001	0.001	0.001	75
2f1	0.001	0.02	0.02	0.02	0.001	150
2f4	0.001	0.10	0.12	0.16	0.001	225
2f3	0.001	0.42	0.60	0.68	0.001	300
2g4	0.10	0.05	0.05	0.001	0.10	-100
2g5	0.10	0.12	0.12	0.13	0.12	75
2g3	0.09	0.20	0.60	0.80	0.08	150
2g1	0.10	1.9	1.5	1.1	0.09	225
2g2	0.12	0.13	0.82	1.22	0.10	300
2h4	0.001	0.001	0.001	0.001	0.001	-100
2h5	"	"	"	"	"	75
2h3	"	"	"	"	"	150
2h1	"	"	"	"	"	225
2h2	"	"	"	"	"	300
8a4	"	"	"	"	"	-100
8a5	"	"	"	"	"	75
8a3	"	"	"	"	"	150
8a1	"	"	"	"	"	225
8a2	"	"	"	"	"	300
8a14	"	"	"	"	"	-100
8a15	"	"	"	"	"	75
8a13	"	"	"	"	"	150
8a11	"	"	0.03	0.25	"	225
8a12	"	0.29	0.25	0.22	"	300
8b4	"	0.001	0.001	0.001	0.001	-100
8b5	"	"	"	"	"	75
8b3	"	"	"	"	"	150
8b1	"	"	"	"	"	225
8b2	"	0.04	0.04	0.04	"	300

Table 3 (cont.)

DISSIPATION FACTOR

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Dissipation Factor Before Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
8c4	0.001	0.001	0.001	0.001	0.001	-100
8c5	"	"	"	"	"	75
8c3	"	"	" "	"	"	150
8c1	"	"	"	"	"	225
8c2	"	"	"	"	"	300
8c14	"	"	"	"	"	-100
8c15	"	"	"	"	"	75
8c13	"	"	"	"	"	150
8c11	"	"	"	"	"	225
8c12	"	"	"	"	"	300
8c24	"	"	"	"	"	-100
8c25	"	"	"	"	"	75
8c23	"	"	"	"	"	150
8c21	"	"	"	"	"	225
8c22	"	0.01	0.01	0.08	0.07	300
8c34	"	0.001	0.001	0.001	0.001	-100
8c35	"	"	"	"	"	75
8c33	"	"	"	"	"	150
8c31	"	"	"	"	"	225
8c32	"	"	"	"	"	300
8c44	"	"	"	"	"	-100
8c45	"	"	"	"	"	75
8c43	"	"	"	"	"	150
8c41	"	"	"	"	"	225
8c42	"	"	"	"	"	300
8c54	"	"	"	"	"	-100
8c55	"	"	"	"	"	75
8c53	"	0.05	0.055	0.055	"	150
8c51	0.085	0.001	0.001	0.001	"	225
8c52	0.001	0.885	0.085	0.085	"	300
8c64	"	0.001	0.001	0.001	"	-100
8c65	"	"	"	"	"	75
8c63	"	"	"	"	"	150
8c61	"	"	"	"	"	225
8c62	"	0.05	0.12	0.12	"	300
8d4	"	0.001	0.001	0.001	"	-100
8d5	"	"	"	"	"	75
8d3	"	"	"	"	"	150
8d1	"	"	"	"	"	225
8d2	"	"	"	"	"	300

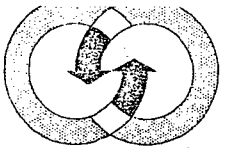


Table 3 (cont.)

DISSIPATION FACTOR

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Dissipation Factor Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	Exposure	Temp. °F
8f4	0.001	0.001	0.001	0.001	0.001	-100
8f5	"	"	"	"	"	75
8f3	"	"	"	"	"	150
8f1	"	"	"	"	"	225
8f2	"	"	"	"	"	300
8f14	"	0.11	0.10	0.10	"	-100
8f15	"	0.001	0.001	0.001	"	75
8f13	"	"	"	"	"	150
8f11	"	0.03	0.04	0.06	"	225
8f12	"	0.046	0.046	0.046	"	300

NOTE: The sign < applies to values of Dissipation Factor which are 0.001.

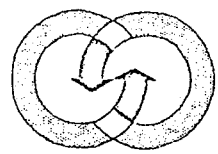


Table 4

INSULATION RESISTANCE

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

General Radio, Type 1862-B Megohmmeter was used to obtain the following data.

Sample No.	Before Exposure	Insulation Resistance-megohms In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
1a4	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	-100
1a5	"	"	"	"	"	75
1a3	"	"	"	"	"	150
1a1	"	"	"	"	"	225
1a2	"	"	"	"	"	300
1b4	"	"	"	"	"	-100
1b5	"	"	"	"	"	75
1b1	"	"	"	"	"	150
1b2	"	"	"	"	"	225
1b3	"	"	"	"	"	300
1c4	"	"	"	"	"	-100
1c5	"	"	"	"	"	75
1c1	"	"	"	"	"	150
1c3	"	"	"	"	"	225
1c2	"	"	"	"	"	300
1d4	"	"	"	"	"	-100
1d5	"	"	"	"	"	75
1d3	"	"	"	"	"	150
1d1	"	1.8×10^{6}	1.1×10^{6}	9.0×10^{5}	9.0×10^{5}	225
1d2	"	6.5×10^{5}	6.0×10^{5}	6.0×10^{5}	2.0×10^{6}	300
1e6	"	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	"	-100
1e1	"	"	"	"	"	75
1e2	"	"	"	"	"	150
1e5	"	"	"	"	"	225
1e3	"	"	"	"	"	300
1e15	"	"	"	"	"	-100
1e11	"	"	"	"	"	75
1e14	"	"	"	"	"	150
1e13	"	"	"	"	"	225
1e12	"	"	"	"	"	300
1e25	"	"	"	"	"	-100
1e21	"	"	"	"	"	75
1e23	"	"	"	"	"	150
1e22	"	"	"	"	"	225
1e24	"	"	"	"	"	300

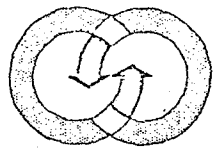


Table 4 (cont.)

INSULATION RESISTANCE

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Insulation Resistance-megohms: Before Exposure	In Vacuo: 1st day	In Vacuo: 4th day	In Vacuo: 7th day	After Exposure	Temp. °F
1e35	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	-100
1e31	"	"	"	"	"	75
1e32	"	"	"	"	"	150
1e33	"	"	"	"	"	225
1e34	"	"	"	"	"	300
1f6	"	"	"	"	"	-100
1f1	"	"	"	"	"	75
1f2	"	"	"	"	"	150
1f4	"	"	"	"	"	225
1f3	"	"	"	"	"	300
1g4	5.0×10^{4}	"	"	"	4.0×10^{5}	-100
1g5	7.4×10^{4}	2.4×10^{5}	2.5×10^{5}	2.4×10^{5}	6.8×10^{5}	75
1g3	3.4×10^{5}	1.9×10^{6}	1.9×10^{6}	1.9×10^{6}	2.0×10^{6}	150
1g1	1.9×10^{5}	2.0×10^{6}	1.9×10^{6}	1.8×10^{6}	"	225
1g2	6.2×10^{4}	5.0×10^{5}	1.3×10^{6}	2.0×10^{6}	"	300
1h4	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	"	"	-100
1h5	"	"	"	"	"	75
1h3	"	2.4×10^{5}	2.4×10^{5}	2.2×10^{5}	"	150
1h2	"	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	"	225
1h1	"	"	"	"	"	300
2a5	"	"	"	"	"	-100
2a4	"	"	"	"	"	75
2a3	"	"	"	"	"	150
2a2	"	"	"	"	"	225
2a1	"	"	"	"	"	300
2b4	"	"	"	"	"	-100
2b5	"	"	"	"	"	75
2b3	"	"	"	"	"	150
2b2	"	"	"	"	"	225
2b1	"	"	"	"	"	300
2c6	"	"	"	"	"	-100
2c1	"	"	"	"	"	75
2c2	"	"	"	"	"	150
2c5	"	"	"	"	"	225
2c3	"	"	"	"	"	300
2d5	"	"	"	"	"	-100
2d4	"	"	"	"	"	75
2d3	"	"	"	"	"	150
2d2	"	"	"	"	"	225
2d1	"	"	"	"	"	300

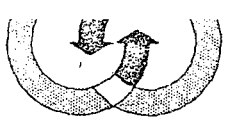


Table 4 (cont..)

INSULATION RESISTANCE

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Insulation Resistance-megohms: Before Exposure	In Vacuo: 1st day	In Vacuo: 4th day	In Vacuo: 7th day	After Exposure	Temp. °F
2e4	6.0×10^{5}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	1.0×10^{6}	-100
2e5	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	75
2e3	7.0×10^{5}	8.0×10^{4}	6.6×10^{4}	5.4×10^{4}	1.2×10^{6}	150
2e1	8.0×10^{5}	6,650	5,500	5,800	1.6×10^{6}	225
2e2	7.0×10^{5}	380	420	500	5.0×10^{5}	300
2f5	1.2×10^{5}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.4×10^{5}	-100
2f2	3.3×10^{5}	4.0×10^{5}	4.8×10^{5}	2.1×10^{5}	3.1×10^{5}	75
2f1	2.2×10^{5}	7,700	7,800	7,200	3.3×10^{5}	150
2f4	1.5×10^{5}	1,850	1,500	1,500	3.3×10^{4}	225
2f3	2.6×10^{5}	150	122	105	8.8×10^{4}	300
2g4	320	1.3×10^{6}	1.5×10^{6}	7.0×10^{5}	580	-100
2g5	500	410	490	460	620	75
2g3	560	240	130	80	1,300	150
2g1	530	95	118	280	820	225
2g2	360	40	58	76	4,300	300
2h4	7.0×10^{5}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	1.2×10^{6}	-100
2h5	1.0×10^{5}	1.7×10^{5}	1.5×10^{5}	1.4×10^{5}	1.6×10^{6}	75
2h3	8.0×10^{6}	4.9×10^{6}	1.9×10^{5}	1.3×10^{4}	2.0×10^{6}	150
2h1	1.2×10^{6}	1.9×10^{6}	5.2×10^{5}	3.2×10^{4}	2.0×10^{6}	225
2h2	1.9×10^{4}	8,200	8,200	8,200	2.0×10^{6}	300
8a4	7.3×10^{4}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	4.8×10^{5}	-100
8a5	6.4×10^{4}	8.0×10^{4}	7.0×10^{4}	8.0×10^{4}	8.0×10^{5}	75
8a3	5.5×10^{4}	8.0×10^{5}	6.4×10^{4}	5.0×10^{4}	1.7×10^{5}	150
8a1	5.9×10^{4}	2.2×10^{3}	7.3×10^{3}	1.1×10^{3}	7.0×10^{4}	225
8a2	9.8×10^{4}	2.3×10^{6}	2.1×10^{6}	2.0×10^{6}	2.4×10^{4}	300
8a14	1.2×10^{3}	2.0×10^{5}	2.0×10^{5}	2.0×10^{5}	5.3×10^{4}	-100
8a15	7.6×10^{3}	4.3×10^{4}	4.1×10^{4}	2.5×10^{5}	2.7×10^{5}	75
8a13	8.5×10^{3}	4.0×10^{4}	1.0×10^{3}	7,000	1.0×10^{3}	150
8a11	6.1×10^{4}	1.2×10^{4}	6.1×10^{3}	1.2×10^{3}	8.0×10^{4}	225
8a12	1.7×10^{6}	1,300	1,530	1,700	2.8×10^{6}	300
8b4	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	-100
8b5	2.0×10^{6}	2.0×10^{5}	1.6×10^{5}	1.0×10^{5}	2.0×10^{6}	75
8b3	2.0×10^{6}	6.0×10^{3}	4.2×10^{3}	2.6×10^{4}	2.0×10^{6}	150
8b1	2.0×10^{6}	2.2×10^{3}	7.3×10^{3}	2.1×10^{4}	2.0×10^{6}	225
8b2	2.0×10^{4}	570	1,200	2,000	2.0×10^{5}	300
8c4	5.0×10^{4}	1.9×10^{4}	1.9×10^{5}	2.0×10^{5}	2.2×10^{4}	-100
8c5	2.6×10^{4}	8.3×10^{4}	2.4×10^{4}	2.6×10^{4}	7.1×10^{4}	75
8c3	2.0×10^{5}	2.7×10^{5}	5.8×10^{5}	5.9×10^{5}	3.7×10^{6}	150
8c1	1.5×10^{5}	3.1×10^{5}	4.1×10^{5}	4.7×10^{5}	1.1×10^{6}	225

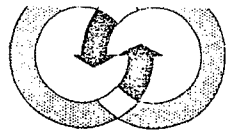


Table 4 (cont.)

INSULATION RESISTANCE

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Before Exposure	Insulation Resistance-megohms In Vacuo 1st day	4th day	7th day	After Exposure	Temp. °F
8c2	1.5×10^{5}	5.0×10^{4}	6.2×10^{4}	7.0×10^{4}	2.0×10^{6}	300
8c14	3.3×10^{4}	4.0×10^{5}	7.0×10^{5}	7.0×10^{5}	4.8×10^{4}	-100
8c15	4.2×10^{4}	5.1×10^{5}	8.2×10^{5}	8.3×10^{5}	5.4×10^{4}	75
8c13	3.7×10^{5}	4.4×10^{6}	7.0×10^{6}	6.0×10^{6}	4.5×10^{5}	150
8c11	1.8×10^{4}	2.0×10^{5}	1.9×10^{5}	1.5×10^{5}	5.0×10^{6}	225
8c12	5.0×10^{5}	6.0×10^{5}	7.0×10^{5}	7.0×10^{5}	2.0×10^{6}	300
8c24	4.3×10^{5}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	1.9×10^{6}	-100
8c25	6.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	75
8c23	1.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	150
8c21	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	225
8c22	2.0×10^{5}	1.9×10^{5}	2.0×10^{4}	2.0×10^{4}	2.0×10^{4}	300
8c34	2.6×10^{5}	1.4×10^{5}	9.5×10^{4}	5.9×10^{5}	1.3×10^{5}	-100
8c35	4.2×10^{5}	2.0×10^{5}	1.1×10^{5}	1.4×10^{5}	3.8×10^{5}	75
8c33	3.8×10^{5}	6.6×10^{4}	2.5×10^{6}	2.7×10^{6}	6.0×10^{6}	150
8c31	8.0×10^{5}	2.0×10^{6}	1.7×10^{5}	1.0×10^{5}	2.0×10^{6}	225
8c32	8.0×10^{5}	3.2×10^{5}	5.0×10^{6}	6.0×10^{6}	2.0×10^{6}	300
8c44	1.7×10^{5}	1.6×10^{5}	1.9×10^{5}	1.9×10^{5}	1.4×10^{5}	-100
8c45	5.0×10^{5}	8.0×10^{5}	8.0×10^{5}	7.0×10^{5}	7.0×10^{5}	75
8c43	4.6×10^{6}	5.0×10^{6}	5.0×10^{6}	4.5×10^{6}	8.0×10^{6}	150
8c41	1.9×10^{5}	1.5×10^{5}	1.6×10^{6}	1.6×10^{6}	2.0×10^{6}	225
8c42	7.0×10^{5}	4.0×10^{5}	2.0×10^{6}	1.0×10^{6}	2.0×10^{5}	300
8c54	1.2×10^{6}	2.0×10^{5}	2.0×10^{5}	2.0×10^{6}	7.0×10^{6}	-100
8c55	7.0×10^{5}	7.0×10^{5}	8.0×10^{5}	1.0×10^{4}	1.4×10^{6}	75
8c53	4.5×10^{4}	2.5×10^{4}	2.3×10^{3}	1.7×10^{3}	2.0×10^{6}	150
8c51	2.8×10^{5}	5.4×10	4.6×10	3.8×10	2.0×10^{6}	225
8c52	3.5×10^{5}	500	1,330	1,250	2.0×10^{6}	300
8c64	1.5×10^{5}	2.0×10^{5}	2.0×10^{6}	2.0×10^{6}	9.0×10^{5}	-100
8c65	2.2×10^{5}	8.0×10^{5}	2.0×10^{6}	2.0×10^{6}	7.0×10^{5}	75
8c63	1.8×10^{5}	1.2×10^{6}	1.8×10^{6}	1.8×10^{6}	9.0×10^{6}	150
8c61	3.6×10^{5}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	225
8c62	3.4×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	300
8d4	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	-100
8d5	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	75
8d3	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	150
8d1	2.0×10^{6}	2.0×10^{4}	1.9×10^{5}	1.8×10^{5}	2.0×10^{6}	225
8d2	2.0×10^{6}	3.0×10^{4}	1.7×10^{5}	1.4×10^{6}	2.0×10^{6}	300
8f4	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	2.0×10^{6}	-100
8f5	2.0×10	2.0×10	2.0×10	2.0×10	2.0×10	75

Table 4 (cont.)

INSULATION RESISTANCE

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Insulation Resistance-megohms Before Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
8f3	2.0×10^6	2.0×10^6	2.0×10^6	2.0×10^6	2.0×10^6	150
8f1	"	"	"	"	"	225
8f2	"	"	"	"	"	300
8f14	"	"	"	"	"	-100
8f15	"	"	"	"	"	75
8f13	"	"	"	"	"	150
8f11	"	4.2×10^5	6.0×10^5	8.0×10^5	"	225
8f12	"	1.9×10^4	1.8×10^4	3.0×10^4	"	300

NOTE: The sign > applies to values of Insulation Resistance which are 2.0×10^6.

Table 5

WEIGHT STABILITY

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

An Ainsworth Chainomatic Balance, Type DLB, was used to obtain the following results.

Sample No.	% Weight Change	Temp. °F	Sample No.	% Weight Change	Temp. °F	Sample No.	% Weight Change	Temp. °F
1a4a°	-0.01	-100	1e15	-0.03	-100	1h4	-0.01	-100
1a5	-0.01	75	1e11	-0.07	75	1h5	-0.03	75
1a3a	-0.02	150	1e14	-0.08	150	1h3a	-0.06	150
1a1a	-0.03	225	1e13	-0.20	225	1h2a	-0.14	225
1a2a	-0.06	300	1e12	-0.31	300	1h1a	-0.17	300
1b4a	-0.01	-100	1e21	-0.10	-100	2a5	0.00	-100
1b5	-0.03	75	1e25	-0.09	75	2a4	0.00	75
1b1a	-0.05	150	1e23	-0.10	150	2a3	0.00	150
1b2a	-0.11	225	1e22	-0.47	225	2a2	-0.58	225
1b3a	-0.24	300	1e24	-0.61	300	2a1	-1.09	300
1c4	-0.06	-100	1e35	-0.04	-100	2b4	-0.48	-100
1c5	-0.14	75	1e31	-0.06	75	2b5	-0.55	75
1c1	-0.29	150	1e32	-0.09	150	2b3	-0.64	150
1c3	-0.31	225	1e33	-0.29	225	2b2	-1.11	225
1c2	-0.34	300	1e34	-0.42	300	2b1	-1.26	300
1d4	-0.04	-100	1f6	-0.01	-100	2c6	+0.03	-100
1d5	-0.13	75	1f1	-0.02	75	2c1	-0.04	75
1d3	-0.32	150	1f2	-0.03	150	2c2	-0.05	150
1d1	-0.57	225	1f4	-0.09	225	2c5	0.00	225
1d2	-0.69	300	1f3	-0.08	300	2c3	-0.07	300
1e6	-0.02	-100	1g4	-0.04	-100	2d5	-0.03	-100
1e1	-0.07	75	1g5	-0.23	75	2d4	-0.13	75
1e2	-0.08	150	1g3	-0.88	150	2d1	-0.23	150
1e5	-0.27	225	1g1	-1.24	225	2d2	-0.24	225
1e3	-0.35	300	1g2	-6.00	300	2d1	-0.25	300
2e4	-0.01	-100	4b4	-0.13	-100	6d5	-0.06	-100
2e5	-0.08	75	4b1	-0.30	75	6d1	-0.13	75
2e3	-0.19	150	4b2	-0.40	150	6d2	-0.15	150
2e1	-0.86	225	4b5	-0.32	225	6d4	-0.12	225
2e2	-1.74	300	4b3	-0.80	300	6d3	-0.20	300
2f5	-0.09	-100	5a5	-0.21	-100	7a1	-0.14	-100
2f2	-0.32	75	5a2	-0.30	75	7a2	-0.30	75
2f1	-1.00	150	5a3	-1.10	150	7a3	-1.20	150
2f4	-1.39	225	5a1	-1.68	225	7a5	-1.16	225
2f3	-1.92	300	5a4	-1.50	300	7a4	-2.00	300

Table 5 (cont.)
WEIGHT STABILITY
Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	% Weight Change	Temp. °F	Sample No.	% Weight Change	Temp. °F	Sample No.	% Weight Change	Temp. °F
2g4	-0.73	-100	6a1	0.00	-100	7b1	-0.08	-100
2g5	-0.84	75	6a2	+0.02	75	7b2	-0.20	75
2g3	-1.56	150	6a3	-0.14	150	7b3	-1.10	150
2g1	-4.07	225	6a5	-0.74	225	7b6	-2.24	225
2g2	-6.65	300	6a4	melted	300	7b4	-2.10	300
2h4	-0.06	-100	6b1	-0.01	-100	7c5	-0.07	-100
2h5	-0.09	75	6b2	+0.03	75	7c2	-0.20	75
2h3	-0.13	150	6b3	-0.07	150	7c3	-0.50	150
2h1	-0.12	225	6b5	-0.25	225	7c4	-0.74	225
2h2	-0.16	300	6b4	-0.44	300	7c1	-1.10	300
4a4	-0.03	-100	6c4	-0.15	-100	8a4	-0.20	-100
4a1	-0.08	75	6c1	-0.30	75	8a5	-0.43	75
4a2	-0.50	150	6c2	-0.80	150	8a3	-0.72	150
4a5	-1.29	225	6c5	-1.36	225	8a1	-1.17	225
4a3	-2.00	300	6c3	-4.30	300	8a2	-2.93	300
8a14	-0.25	-100	8c34	+0.08	-100	8f4	+0.07	-100
8a15	-0.36	75	8c35	-0.84	75	8f5	-0.05	75
8a13	-0.59	150	8c33	-2.99	150	8f3	-0.04	150
8a11	-0.99	225	8c31	-3.23	225	8f1	0.00	225
8a12	-3.19	300	8c32	-4.15	300	8f2	-0.11	300
8b4	-0.13	-100	8c44	0.00	-100	8f14	0.00	-100
8b5	-0.43	75	8c45	-0.32	75	8f15	-0.04	75
8b3	-0.87	150	8c43	-0.66	150	8f13	-0.12	150
8b1	-4.96	225	8c41	-1.40	225	8f11	-0.15	225
8b2	-15.17	300	8c42	-1.74	300	8f12	-0.08	300
8c4	-0.07	-100	8c54	-0.15	-100	1a1b*	-0.07	225
8c5	-0.18	75	8c55	-0.27	75	1a2c**	-0.25	300
8c3	-0.57	150	8c53	-0.85	150	1a2d***	-0.14	300
8c1	-1.32	225	8c51	-4.92	225	1a3c	-0.23	150
8c2	-2.03	300	8c52	-3.56	300	1a3d	-0.04	150
8c14	-0.14	-100	8c64	0.00	-100	1a4d	-0.02	-100
8c15	-0.23	75	8c65	-0.21	75	1b1d	-0.10	150
8c13	-0.57	150	8c63	-0.67	150	1b2d	-0.43	225
8c11	-0.90	225	8c61	-1.10	225	1b3d	-0.66	300
8c12	-1.87	300	8c62	-1.24	300	1b4d	-0.01	-100
8c24	-0.04	-100	8d4	-0.06	-100	1h1b	-0.15	300
8c25	-0.12	75	8d5	-0.36	75	1h2b	-0.07	225
8c23	-0.38	150	8d3	-0.76	150	1h2c	-4.82	225
8c21	-1.40	225	8d1	-2.73	225	1h3b	-0.03	150
8c22	-1.85	300	8d2	-5.85	300	1h3c	-3.15	150

Table 5 (cont.)

WEIGHT STABILITY

° a - Connector Insert Proper

* b - Connector Insert Metal Body

** c - Connector Insert "Rubber Retainer Ring"

*** d - Connector Insert Proper Pieces

Table 5 (cont.)

WEIGHT STABILITY

Before and After Ultra High Vacuum Exposure (10^{-8} - 10^{-9} torr)

An Ainsworth Chainomatic Balance, Type DLB, was used to obtain the following results.

Sample No.	% Weight Change	Temp. °F	Sample No.	% Weight Change	Temp. °F	Sample No.	% Weight Change	Temp. °F
1a6	-0.32	225						
1b6	-1.48	225						
1c6	-0.29	225						
1e16	-0.54							
1f7	-0.23							
1h6	-0.27							
2a7	-0.16							
2c7	-0.02							
2d7	-0.32							
2h7	-0.24							
4b7	-0.64							
6b7	-0.64							
6d6	-0.18							
8f6	0.00							
8f16	-0.06							

Table 6

INSULATION RESISTANCE

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

General Radio, Type 1862-B Megohmmeter was used to obtain the following data.

Sample No.	Insulation Resistance Megohms Before	After	Temp. °F
4a4	2.1×10^5_4	8.0×10^5_5	-100
4a1	1.7×10^4	2.0×10^5_5	75
4a2	4.0×10^5_5	2.8×10^6	150
4a5	1.0×10^4_4	2.0×10^5_5	225
4a3	3.6×10^5_5	3.1×10^5_5	300
4b4	1.2×10^4_4	7.0×10^5_5	-100
4b1	3.8×10^4_4	4.0×10^4_4	75
4b2	3.2×10^5_5	2.5×10^6	150
4b5	7.0×10^4_4	2.0×10^6_4	225
4b3	3.2×10^5_5	8.7×10^5_5	300
6a1	4.5×10^5_5	3.0×10^5_5	-100
6a2	5.9×10^5_5	1.8×10^4_4	75
6a3	3.2×10^5_5	7.6×10^3_3	150
6a5	3.5×10^5_5	1.9×10^3	225
6a4	1.0×10^6	---	300
6b1	1.0×10^6	1.4×10^6_6	-100
6b2	1.5×10^6	1.4×10^6_6	75
6b3	1.8×10^5_5	1.7×10^6_6	150
6b5	8.0×10^6_6	2.0×10^6_6	225
6b4	1.7×10^6_6	2.0×10^6_6	300
6c4	1.5×10^6_6	2.0×10^5_5	-100
6c1	2.0×10^6_6	3.1×10^6_6	75
6c2	1.5×10^6_6	1.5×10^6_6	150
6c5	1.0×10^6_6	1.8×10^5_5	225
6c3	1.4×10^6_6	5.5×10^4_4	300
6d5	1.6×10^4_4	1.7×10^4_4	-100
6d1	1.9×10^4_4	1.4×10^4_4	75
6d2	5.0×10^4_4	5.6×10^4_4	150
6d4	1.7×10^4_4	2.0×10^4_4	225
6d3	1.5×10^4	1.1×10^4_4	300

NOTE: The sign> applies to values of Insulation Resistance which are 2.0×10^6.

Table 7

DIMENSIONAL STABILITY

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Calipers, accurate to one thousandth of a centimeter, were used to obtain the data below.

Sample No.	Length Centimeter Before	Length Centimeter After	Width * Centimeter Before	Width * Centimeter After	Thickness ° Centimeter Before	Thickness ° Centimeter After	Temp. °F
4a4	6.58	6.58	4.23	4.23	0.035	0.035	-100
4a1	6.58	6.58	4.23	4.22	0.035	0.035	75
4a2	6.62	6.62	4.24	4.19	0.035	0.037	150
4a5	6.52	6.47	4.21	3.87	0.033	0.040	225
4a3	6.35	5.78	4.19	2.15	0.034	0.073	300
4b4	17.32	17.32	2.02	2.02	0.009	0.009	-100
4b1	17.32	17.32	2.02	2.02	0.009	0.009	75
4b2	17.54	17.08	2.03	1.97	0.009	0.010	150
4b5	17.20	13.87	2.02	1.65	0.009	0.014	225
4b3	17.15	13.12	2.03	1.58	0.009	0.015	300
5a5	2.54	2.54	1.39	1.39	0.96	0.96	-100
5a2	2.54	2.53	1.39	1.38	0.96	0.96	75
5a3	2.53	2.53	1.39	1.39	0.97	0.98	150
5a1	2.54	2.52	1.39	1.38	0.97	0.97	225
5a4	2.52	2.52	1.39	1.38	0.97	0.97	300
7a1	1.91	1.91	0.81	0.81	0.12	0.12	-100
7a2	1.91	1.91	0.81	0.81	0.12	0.12	75
7a3	1.91	1.91	0.81	0.81	0.12	0.12	150
7a5	1.91	1.90	0.81	0.81	0.14	0.13	225
7a4	1.94	1.93	0.81	0.80	0.12	0.12	300
7b1	4.08	4.08	1.25	1.25	0.32	0.32	-100
7b2	4.08	4.08	1.25	1.25	0.32	0.32	75
7b3	4.08	4.07	1.25	1.26	0.31	0.31	150
7b6	4.08	4.05	1.24	1.25	0.32	0.32	225
7b4	4.08	4.04	1.26	1.25	0.32	0.32	300
7c5	5.08	5.08	1.66	1.66	0.16	0.16	-100
7c2	5.07	5.04	1.66	1.66	0.16	0.16	75
7c3	5.09	5.04	1.65	1.65	0.16	0.16	150
7c4	3.99	3.97	1.65	1.65	0.16	0.16	225
7c4	5.10	5.05	1.66	1.65	0.16	0.16	300

*For the 5a samples the measurements in this column is the outer diameter.

°For the 5a samples the measurements in this column in the inner diameter.

Table 8

HARDNESS

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Shore Instrument, Type "A-2" was used to obtain the following data.

Sample No.	Hardness-Duro* Before	After	Temp. °F	Sample No.	Hardness-Duro* Before	After	Temp. °F
1a4	84	84	-100	1e15	100	100	-100
1a5	84	84	75	1e11	100	100	75
1a3	84	84	150	1e14	100	100	150
1a1	84	84	225	1e13	100	100	225
1a2	84	82	300	1e12	100	100	300
1b4	58	57	-100	1e21	100	100	-100
1b5	58	58	75	1e25	100	100	75
1b1	58	60	150	1e23	100	100	150
1b2	58	58	225	1e22	100	100	225
1b3	58	56	300	1e24	100	100	300
1c4	44	44	-100	1e35	100	100	-100
1c5	44	44	75	1e21	100	100	75
1c1	44	45	150	1e32	100	100	150
1c3	44	44	225	1e33	100	100	225
1c2	44	44	300	1e34	100	100	300
1d4	80	82	-100	1f6	100	100	-100
1d5	80	81	75	1f1	100	100	75
1d3	80	82	150	1f2	100	100	150
1d1	80	81	225	1f4	100	100	225
1d2	80	81	300	1f3	100	100	300
1e6	100	100	-100	1g4	100	100	-100
1e1	100	100	75	1g5	100	100	75
1e2	100	100	150	1g3	100	100	150
1e5	100	100	225	1g1	100	100	225
1e3	100	100	300	1g2	100	100	300
1h4	67	76	-100	2e4	79	81	-100
1h5	67	72	75	2e5	79	79	75
1h3	67	67	150	2e3	79	79	150
1h2	67	70	225	2e1	79	82	225
1h1	67	70	300	2e2	79	83	300
2a5	100	100	-100	2f5	66	69	-100
2a4	100	100	75	2f2	66	72	75
2a3	100	100	150	2f1	66	69	150
2a2	100	100	225	af4	66	71	225
2a1	100	100	300	2f3	66	72	300
2b4	100	100	-100	2g4	69	72	-100
2b5	100	100	75	2g5	69	72	75

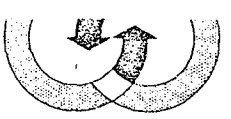


Table 8 (cont.)

HARDNESS (cont)

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Hardness-Duro* Before	After	Temp. °F	Sample No.	Hardness-Duro* Before	After	Temp. °F
2b3	100	100	150	2g3	69	72	150
2b2	100	100	225	2g1	69	72	225
2b1	100	100	300	2g2	69	71	300
2c6	99	100	-100	2h4	79	79	-100
2c1	99	99	75	2h5	79	79	75
2c2	99	99	150	2h3	79	78	150
2c5	99	99	225	2h1	79	76	225
2c3	99	99	300	2h2	79	80	300
2d5	96	98	-100	8a4	84	88	-100
2d4	96	98	75	8a5	84	89	75
2d3	96	99	150	8a3	84	88	150
2d2	96	96	225	8a1	84	89	225
2d1	96	99	300	8a2	84	90	300
8a14	74	87	-100	8c34	77	78	-100
8a15	74	87	75	8c35	77	78	75
8a13	74	86	150	8c33	77	78	150
8a11	74	87	225	8c31	77	79	225
8a12	74	86	300	8c32	77	79	300
8b4	99	100	-100	8c44	76	79	-100
8b5	99	99	75	8c45	76	80	75
8b3	99	100	150	8c43	76	80	150
8b1	99	99	225	8c41	76	80	225
8b2	99	99	300	8c42	76	81	300
8c4	78	80	-100	8c54	90	97	-100
8c5	78	78	75	8c55	90	97	75
8c3	78	78	150	8c53	90	97	150
8c1	78	80	225	8c51	90	96	225
8c2	78	79	300	8c52	90	95	300
8c14	79	80	-100	8c64	81	85	-100
8c15	79	79	75	8c65	81	85	75
8c13	79	79	150	8c63	81	84	150
8c11	79	81	225	8c61	81	85	225
8c12	79	81	300	8c62	81	86	300
8c24	80	83	-100	8d4	100	100	-100
8c25	80	83	75	8d5	100	100	75
8c23	80	83	150	8d3	100	100	150
8c21	80	84	225	8d1	100	100	225
8c22	80	83	300	8d2	100	100	300

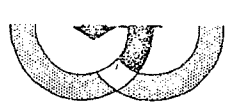


Table 8 (cont.)

HARDNESS (cont)

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Hardness-Duro* Before	After	Temp. °F	Sample No.	Hardness-Duro* Before	After	Temp. °F
8f4	95	100	-100				
8f5	95	99	75				
8f3	95	99	150				
8f1	95	99	225				
8f2	95	99	300				
8f14	100	100	-100				
8f15	100	100	75				
8f13	100	100	150				
8f11	100	100	225				
8f12	100	100	300				

* The sign > applies to all values of 100.

Table 9

DIELECTRIC STRENGTH

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Associated Research, Model 422 Hypot was used to obtain the following data

Sample No.	Dielectric Strength KV Before (>)	After (>)	Temp. °F	Sample No.	Dielectric Strength KV Before (>)	After (>)	Temp. °F
1a4	3.4	4.0	-100	1e15	8.0	8.0	-100
1a5	3.4	3.7	75	1e11	8.0	7.0	75
1a3	3.4	3.8	150	1e14	8.0	8.0	150
1a1	3.4	3.5	225	1e13	8.0	7.0	225
1a2	3.4	4.0	300	1e12	8.0	9.0	300
1b4	3.6	3.4	-100	1e21	8.0	5.0	-100
1b5	3.6	3.5	75	1e25	8.0	5.4	75
1b1	3.6	3.6	150	1e23	8.0	5.0	150
1b2	3.6	3.6	225	1e22	8.0	6.0	225
1b3	3.6	3.2	300	1e24	8.0	5.0	300
1c4	4.0	4.8	-100	1e35	8.0	7.4	-100
1c5	4.0	4.1	75	1e31	8.0	8.0	75
1c1	4.0	4.3	150	1e32	8.0	7.0	150
1c3	4.0	4.0	225	1e33	8.0	8.0	225
1c2	4.0	4.4	300	1e34	8.0	8.0	300
1d4	2.0	3.6	-100	1f6	7.5	10.0	-100
1d5	2.0	2.8	75	1f1	7.5	7.5	75
1d3	2.0	3.0	150	1f2	7.5	7.5	150
1d1	2.0	2.0	225	1f4	7.5	9.0	225
1d2	2.0	2.0	300	1f3	7.5	7.5	300
1e6	8.0	8.4	-100	1g4	10.0	10.0	-100
1e1	8.0	7.4	75	1g5	10.0	6.6	75
1e2	8.0	7.0	150	1g3	10.0	6.8	150
1e5	8.0	6.0	225	1g1	10.0	6.0	225
1e3	8.0	8.0	300	1g2	10.0	6.0	300
1h4	3.0	3.0	-100	2e4	10.0	5.6	-100
1h5	3.0	3.0	75	2e5	10.0	6.0	75
1h3	3.0	3.0	150	2e3	10.0	7.2	150
1h3	3.0	3.0	225	2e1	10.0	7.0	225
1h1	3.0	3.0	300	2e2	10.0	7.0	300
2a5	10.0	6.0	-100	2f5	10.0	6.0	-100
2a4	10.0	6.4	75	2f2	10.0	6.6	75
2a3	10.0	6.2	150	2f1	10.0	6.8	150
2a2	10.0	7.0	225	2f4	10.0	6.0	225
2a1	10.0	6.0	300	2f3	10.0	6.0	300

Table 9 (cont.)

DIELECTRIC STRENGTH (cont)

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Dielectric Strength KV Before (>)	After (>)	Temp. °F	Sample No.	Dielectric Strength KV Before (>)	After (>)	Temp. °F
2b4	10.0	5.4	-100	2g4	10.0	7.4	-100
2b5	10.0	6.6	75	2g5	10.0	7.2	75
2b3	10.0	6.2	150	2g3	10.0	7.9	150
2b2	10.0	6.0	225	2g1	10.0	7.0	225
2b1	10.0	7.0	300	2g2	10.0	7.0	300
2c6	10.0	6.0	-100	2h4	10.0	7.2	-100
2c1	10.0	10.0	75	2h5	10.0	6.8	75
2c2	10.0	6.0	150	2h3	10.0	7.4	150
2c5	10.0	6.0	225	2h1	10.0	6.0	225
2c3	10.0	6.0	300	2h2	10.0	6.4	300
2d5	10.0	5.8	-100	8a4	10.0	6.4	-100
2d4	10.0	5.6	75	8a5	10.0	6.2	75
2d3	10.0	5.8	150	8a3	10.0	5.8	150
2d2	10.0	6.0	225	8a1	10.0	6.0	225
2d1	10.0	5.0	300	8a2	10.0	5.4	300
8a14	10.0	6.6	-100	8c34	10.0	7.0	-100
8a15	10.0	6.4	75	8c35	10.0	6.6	75
8a13	10.0	6.2	150	8c33	10.0	6.4	150
8c11	10.0	5.0	225	8c31	10.0	6.6	225
8a12	10.0	6.0	300	8c32	10.0	4.4*	300
8b4	10.0	6.6	-100	8c44	10.0	5.2	-100
8b5	10.0	6.0	75	8c45	10.0	5.8	75
8b3	10.0	6.0	150	8c43	10.0	6.2	150
8b1	10.0	7.0	225	8c41	10.0	4.0	225
8b2	10.0	5.4	300	8c42	10.0	10.0	300
8c4	10.0	6.6	-100	8c54	10.0	5.2	-100
8c5	10.0	6.2	75	8c55	10.0	5.6	75
8c3	10.0	6.6	150	8c53	10.0	6.4	150
8c1	10.0	6.8	225	8c51	10.0	5.0	225
8c2	10.0	5.6	300	8c52	10.0	6.0	300
8c14	10.0	6.4	-100	8c64	10.0	6.8	-100
8c15	10.0	6.0	75	8c65	10.0	5.6	75
8c13	10.0	6.2	150	8c63	10.0	5.2	150
8c11	10.0	6.4	225	8c61	10.0	4.0	225
8c12	10.0	6.2	300	8c62	10.0	5.4	300
8c24	10.0	6.2	-100	8d4	10.0	5.8	-100
8c25	10.0	6.2	75	8d5	10.0	6.2	75
8c23	10.0	6.0	150	8d3	10.0	6.8	150
8c21	10.0	6.0	225	8d1	10.0	5.0	225
8c22	10.0	6.4	300	8d2	10.0	5.2	300

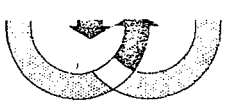


Table 9 (cont.)

DIELECTRIC STRENGTH (cont)

Before and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Dielectric Strength KV Before (>)	After (>)	Temp. °F	Sample No.	Dielectric Strength KV Before (>)	After (>)	Temp. °F
8f4	10.0	6.0	-100				
8f5	10.0	5.6	75				
8f3	10.0	5.8	150				
8f1	10.0	5.0	225				
8f2	10.0	5.8	300				
8f14	10.0	6.0	-100				
8f15	10.0	6.2	75				
8f13	10.0	6.0	150				
8f11	10.0	6.0	225				
8f12	10.0	6.0	300				

* The > sign does not apply to this value.

Table 10
CONDENSIBLE FILM
After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Visual observation was used to obtain data.

Sample No.	Film Rm T	Film LN_2	Sample No.	Film Rm T	Film LN_2	Sample No.	Film Rm T	Film LN_2	Sample No.	Film Rm T	Film LN_2
1a4a	--	--	1e15	--	--	1h4	--	--	2e4	--	--
1a5	--	Cl*	1e11	--	--	1h5	--	Cl	2e5	--	--
1a3a	--	Cl	1e14	--	--	1h3a	Cl	Cl	2e3	--	Sm
1a1a	Sm°	Cl	1e13	--	Tr	1h2a	Cl	Cl	2e1	--	Cd
1a2a	Cl	Cl	1e12	--	Cd***	1h1a	Tr	Tr	2e2	--	Cl
1b4a	--	--	1e25	--	--	2a5	--	--	2f5	--	--
1b5	--	Cl	1e21	--	Cl	2a4	--	--	2f2	--	Tr
1b1a	--	Cl	1e23	--	Cl	2a3	--	--	2f1	--	Cd
1b2a	Sm	Cl	1e22	--	Cl	2a2	--	Tr	2f4	--	Cd
1b3a	Tr**	Tr	1e24	--	Cl	2a1	--	Cd	2f3	Tr	Cd
1c4	--	--	1e35	--	--	2b4	--	--	2g4	--	--
1c5	--	--	1e31	--	--	2b5	--	--	2g5	--	Tr
1c1	--	Cl	1e32	--	--	2b3	--	--	2g3	--	Cd
1c3	--	Sm	1e33	--	Cl	2b2	--	Tr	2g1	Tr	Cd
1c2	--	Sm	1e34	--	Cl	2b1	--	Cd	2g2	Cd	Cd
1d4	--	--	1f6	--	--	2c6	--	--	2h4	--	--
1d5	--	Cl	1f1	--	--	2c1	--	--	2h5	--	Sm
1d3	--	Cl	1f2	--	Sm	2c2	--	Sm	2h3	--	Sm
1d1	--	Sm	1f4	--	Cl	2c5	--	Tr	2h1	--	Cd
1d2	Tr	Sm	1f3	--	Sm	2c3	--	Tr	2h2	--	Tr
1e6	--	--	1g4	--	--	2d5	--	--	4a4	--	--
1e1	--	--	1g5	--	Cl	2d4	--	--	4a1	--	--
1e2	--	Sm	1g3	--	Sm	2d3	--	--	4a2	--	Sm
1e5	--	Cl	1g1	--	Cd	2d2	--	Sm	4a5	Cd	Tr
1e3	--	Cl	1g2	--	Cd	2d1	--	Tr	4a3	Cd	Tr
4b4	--	--	6d5	--	--	8a14	--	--	8c34	--	--
4b1	--	--	6d1	--	--	8a15	--	--	8c35	--	Cl
4b2	--	--	6d2	--	--	8a13	--	--	8c33	--	Cl
4b5	Sm	Cl	6d4	--	Sm	8a11	--	Tr	8c31	--	Cl

Table 10 (cont.)
CONDENSIBLE FILM
After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Film Rm T	Film LN_2	Sample No.	Film Rm T	Film LN_2	Sample No.	Film Rm T	Film LN_2	Sample No.	Film Rm T	Film LN_2
4b3	Tr	Cl	6d3	Sm	Sm	8a12	Sm	Cd	8c32	--	Cl
5a5	--	--	7a1	--	--	8b4	--	--	8c44	--	--
5a2	--	Cl	7a2	--	--	8b5	--	Cl	8c45	--	--
5a3	--	Cl	7a3	Sm	Cl	8b3	--	Cl	8c43	--	--
5a1	Sm	Cl	7a5	Cd	Cl	8b1	--	Cl	8c41	--	Tr
5a4	Sm	Tr	7a4	Cd	Cl	8b2	Sm	Cl	8c42	--	Sm
6a1	--	--	7b1	--	--	8c4	--	--	8c54	--	--
6a2	--	Cd	7b2	--	Cl	8c5	--	--	8c55	--	Tr
6a3	--	Cd	7b3	Sm	Cl	8c3	--	Sm	8c53	--	Cd
6a5	Tr	Cd	7b6	Cd	Cl	8c1	--	Cd	8c51	--	Sm
6a4	Cd	Cd	7b4	Cd	Cl	8c2	--	Sm	8c52	--	Cl
6b1	--	--	7c5	--	--	8c14	--	--	8c64	--	--
6b2	--	--	7c2	--	Cl	8c15	--	Sm	8c65	--	--
6b3	--	Cd	7c3	Cl	Cl	8c13	--	Sm	8c63	--	Sm
6b5	Cl	Cd	7c4	Cl	Cl	8c11	--	--	8c61	--	Tr
6b4	Cl	Cd	7c1	Cl	Cl	8c12	--	--	8c62	--	Sm
6c4	--	--	8a4	--	--	8c24	--	--	8d4	--	--
6c1	--	Cd	8a5	--	Cl	8c25	--	--	8d5	--	--
6c2	--	Cd	8a3	--	Cl	8c23	--	--	8d3	--	--
6c5	--	Cd	8a1	--	Tr	8c21	--	Tr	8d1	--	Cl
6c3	Sm	Cd	8a2	Sm	Sm	8c22	--	Sm	8d2	--	Cd
8f4	--	--	8f5	--	Sm	8f3	--	Sm	8f1	--	Tr
8f2	--	Sm	8f14	--	--	8f12	--	Sm	8f13	--	Sm
8f11	--	Sm	8f12	--	Sm						

* Clear (Cl) - Transmittance of film is approximately 100%, just as for a pane of window glass.

° Smokey (Sm) - Transmittance of film is such that a printed page can be read through it.

** Translucent (Tr) - Transmittance of film is such that a printed page appears blurred through it.

*** Clouded (Cd) - Light transmittance through film is such that only diffuse light is transmitted.

Table 11

CAPACITANCE

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

General Radio, Type 1650-A Impedance Bridge was used to obtain the following data.

	Capacitance - pico farads					
Sample No.	Before Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
1a4	3	3	3	3	3	-100
1a5	3	3	3	3	3	75
1a3	4	3	3	3	3	150
1a1	3	3	3	3	3	225
1a2	3	3	3	3	4	300
1b4	3	3	3	3	4	-100
1b5	4	3	3	3	4	75
1b1	4	3	3	3	4	150
1b2	4	3	3	3	4	225
1b3	4	3	3	3	4	300
1c4	4	4	4	4	4	-100
1c5	3	3	3	3	3	75
1c1	3	3	3	3	3	150
1c3	3	3	3	3	4	225
1c2	3	3	3	3	4	300
1d4	3	3	3	3	3	-100
1d5	3	3	2	3	3	75
1d3	3	2	2	3	3	150
1d1	3	2	3	3	3	225
1d2	3	2	2	2	3	300
1e6	3	3	3	3	3	-100
1e1	2	2	2	2	2	75
1e2	2	1	1	3	2	150
1e5	2	3	3	3	3	225
1e3	2	1	1	2	2	300
1e15	2	3	3	3	2	-100
1e11	2	2	2	2	2	75
1e14	2	1	2	2	2	150
1e13	2	1	2	2	2	225
1e12	2	1	2	2	2	300
1e25	3	3	3	3	3	-100
1e21	3	4	3	3	3	75
1e23	3	3	3	3	3	150
1e22	3	3	3	3	3	225
1e24	3	3	3	2	3	300
1e35	2	2	2	2	2	-100

Table 11 (cont)

CAPACITANCE (cont)

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Capacitance - pico farads: Before Exposure	In Vacuo: 1st day	In Vacuo: 4th day	In Vacuo: 7th day	After Exposure	Temp. °F
1e31	2	2	2	2	2	75
1e32	2	1	2	2	2	150
1e33	2	2	3	3	3	225
1e34	2	2	3	3	3	300
1f6	3	3	2	3	3	-100
1f1	2	2	2	2	2	75
1f2	2	1	1	1	2	150
1f4	2	2	3	3	3	225
1f3	2	2	2	2	2	300
1g4	12	11	11	11	12	-100
1g5	12	11	11	11	12	75
1g3	12	11	11	10	11	150
1g1	12	10	10	10	10	225
1g2	12	10	10	11	11	300
1h4	3	3	3	3	3	-100
1h5	3	3	3	3	3	75
1h3	4	3	3	3	4	150
1h2	3	3	3	2	3	225
1h1	3	3	2	3	3	300
2a5	6	6	6	6	6	-100
2a4	6	6	6	5	6	75
2a3	6	5	5	5	6	150
2a2	5	5	5	5	5	225
2a1	5	4	4	4	5	300
2b4	8	8	8	8	8	-100
2b5	8	8	8	8	8	75
2b3	9	8	8	8	9	150
2b2	7	6	6	6	6	225
2b1	7	6	6	6	6	300
2c6	6	6	6	6	6	-100
2c1	7	6	5	5	5	75
2c2	5	5	5	5	5	150
2c5	5	5	5	5	5	225
2c3	5	5	5	5	5	300
2d5	10	10	10	10	10	-100
2d4	10	10	10	10	10	75
2d3	11	10	10	10	10	150
2d2	10	9	9	9	9	225
2d1	9	9	9	9	9	300

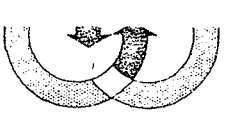


Table 11 (cont)

CAPACITANCE (cont)

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Before Exposure	In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
		Capacitance - pico farads				
2e4	14	9	9	9	14	-100
2e5	13	13	13	12	13	75
2e3	14	13	13	13	14	150
2e1	14	13	13	13	15	225
2e2	12	10	12	13	16	300
2f5	12	11	11	11	12	-100
2f2	9	9	9	9	9	75
2f1	13	11	11	11	12	150
2f4	12	10	11	11	12	225
2f3	12	11	16	17	12	300
2g4	9	6	6	6	8	-100
2g5	9	8	8	8	8	75
2g3	8	9	10	11	7	150
2g1	8	8	6	7	7	225
2g2	6	5	7	8	8	300
2h4	11	7	7	7	12	-100
2h5	9	9	9	9	10	75
2h3	10	10	10	10	12	150
2h1	10	9	8	8	9	225
2h2	8	9	9	9	11	300
8a4	14	12	11	11	13	-100
8a5	13	11	11	11	12	75
8a3	14	12	12	12	13	150
8a1	12	11	11	10	11	225
8a2	12	11	11	11	14	300
8a14	14	12	11	11	13	-100
8a15	12	10	10	10	11	75
8a13	14	12	12	12	13	150
8a11	12	11	11	10	12	225
8a12	12	11	11	11	13	300
8b4	7	6	6	6	7	-100
8b5	6	6	6	6	6	75
8b3	7	6	6	6	6	150
8b1	6	6	7	8	6	225
8b2	6	8	8	8	7	300
8c4	10	9	9	9	9	-100
8c5	8	8	8	8	8	75
8c3	8	8	7	7	9	150
8c1	7	7	7	7	7	225

Table 11 (cont)

CAPACITANCE (cont)

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Before Exposure	Capacitance - pico farads In Vacuo 1st day	In Vacuo 4th day	In Vacuo 7th day	After Exposure	Temp. °F
8c2	6	8	8	8	9	300
8c14	9	9	9	9	10	-100
8c15	9	9	9	9	9	75
8c13	10	9	9	9	10	150
8c11	8	8	8	8	8	225
8c12	8	8	9	9	10	300
8c24	9	9	9	9	9	-100
8c25	9	9	9	9	9	75
8c23	10	9	9	9	10	150
8c21	8	8	8	8	8	225
8c22	9	9	10	11	10	300
8c34	9	9	9	9	9	-100
8c35	9	9	9	9	9	75
8c33	9	8	8	8	9	150
8c31	8	6	7	8	9	225
8c32	9	7	7	7	9	300
8c44	8	9	9	9	9	-100
8c45	8	8	8	8	8	75
8c43	8	8	8	8	8	150
8c41	7	6	6	6	7	225
8c42	8	5	6	7	8	300
8c54	11	9	9	9	11	-100
8c55	12	12	12	12	12	75
8c53	11	12	12	12	10	150
8c51	13	12	12	12	12	225
8c52	10	10	10	10	9	300
8c64	9	9	9	10	9	-100
8c65	9	9	9	9	9	75
8c63	9	8	8	8	9	150
8c61	8	8	8	8	8	225
8c62	9	8	9	9	9	300
8d4	7	6	6	6	6	-100
8d5	7	7	7	7	7	75
8d3	6	6	6	6	6	150
8d1	6	6	7	7	5	225
8d2	7	7	7	7	7	300
8f4	8	7	7	7	7	-100
8f5	8	7	7	7	8	75

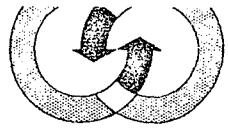
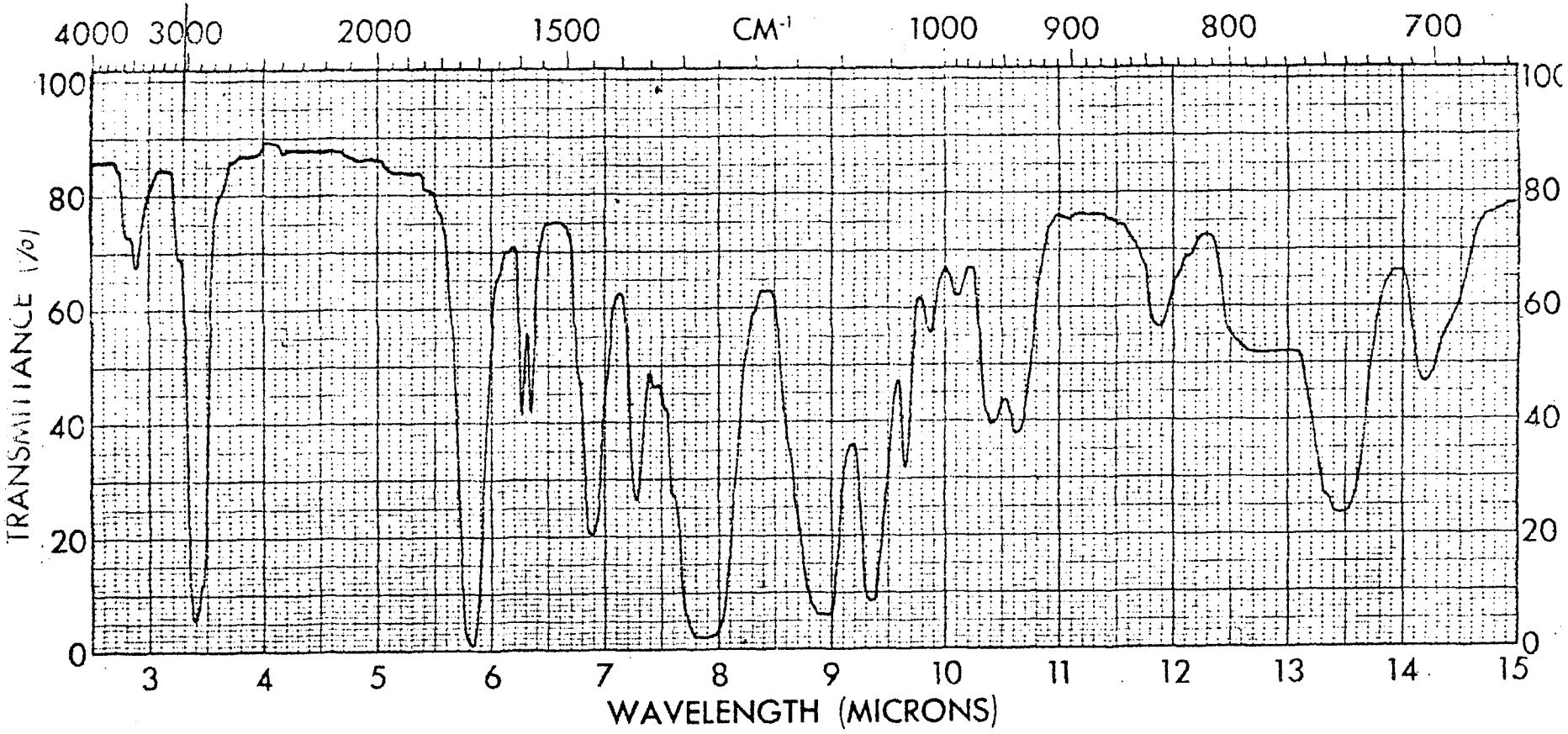


Table 11 (cont)

CAPACITANCE (cont)

Before, During and After Vacuum Exposure (10^{-6} - 10^{-7} torr)

Sample No.	Capacitance - pico farads: Before Exposure	In Vacuo: 1st day	In Vacuo: 4th day	In Vacuo: 7th day	After Exposure	Temp. °F
8f3	8	7	7	7	8	150
8f1	6	7	7	7	6	225
8f2	8	8	8	8	8	300
8f14	16	12	11	11	16	-100
8f15	14	14	13	14	14	75
8f13	13	13	14	13	13	150
8f11	14	15	15	16	15	225
8f12	16	17	17	17	16	300

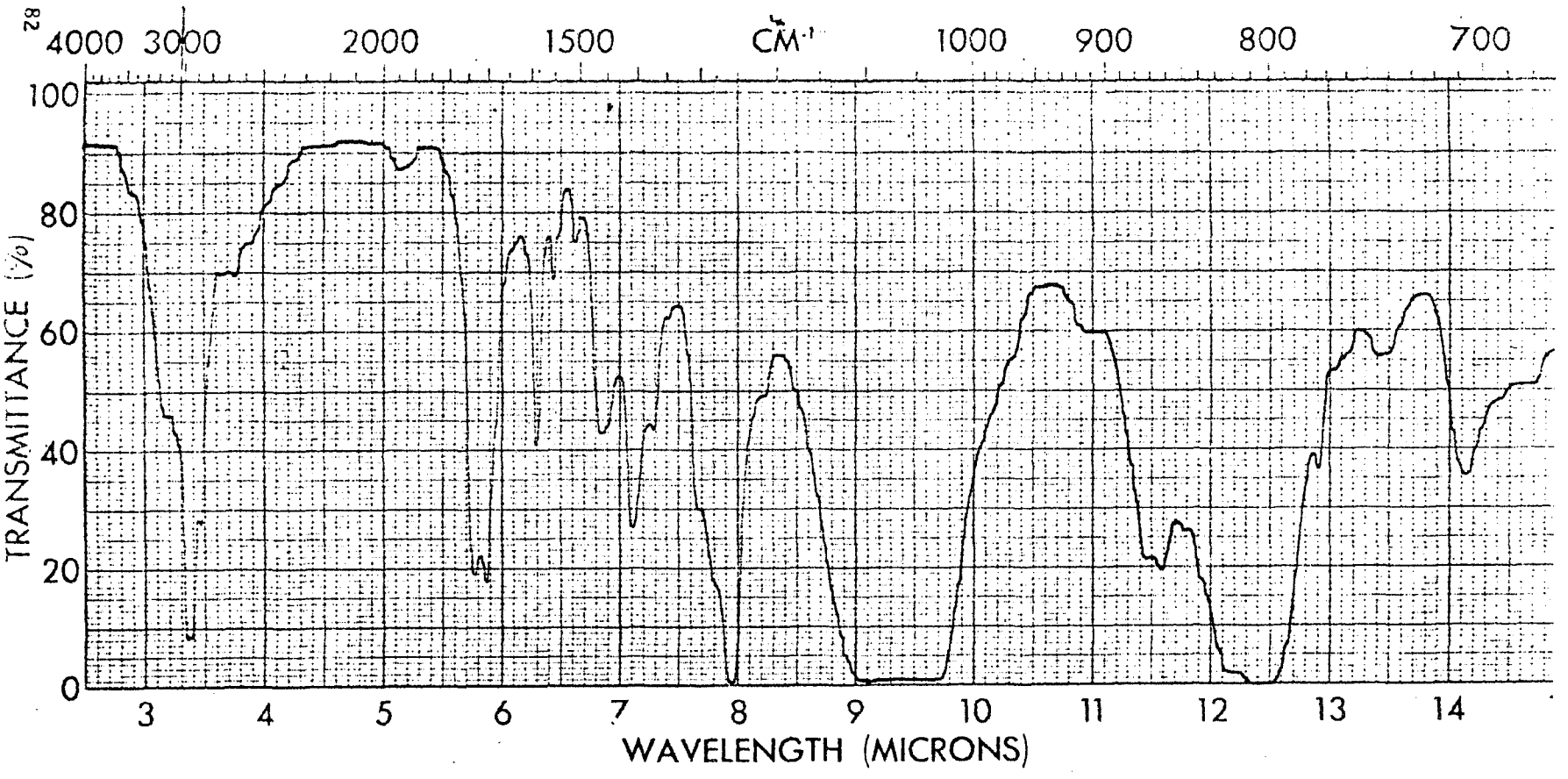


SPECTRUM NO. 97	ORIGIN	LEGEND	REMARKS
SAMPLE 662 Ha. test		1.	
at 300°F. Pale less	PURITY Unk	2.	
Liquid w/ Heated ab	PHASE Liquid	DATE 6/5/63	
IR temp. Area.	THICKNESS Unk	OPERATOR F B K	

ARDEL CORPORATION

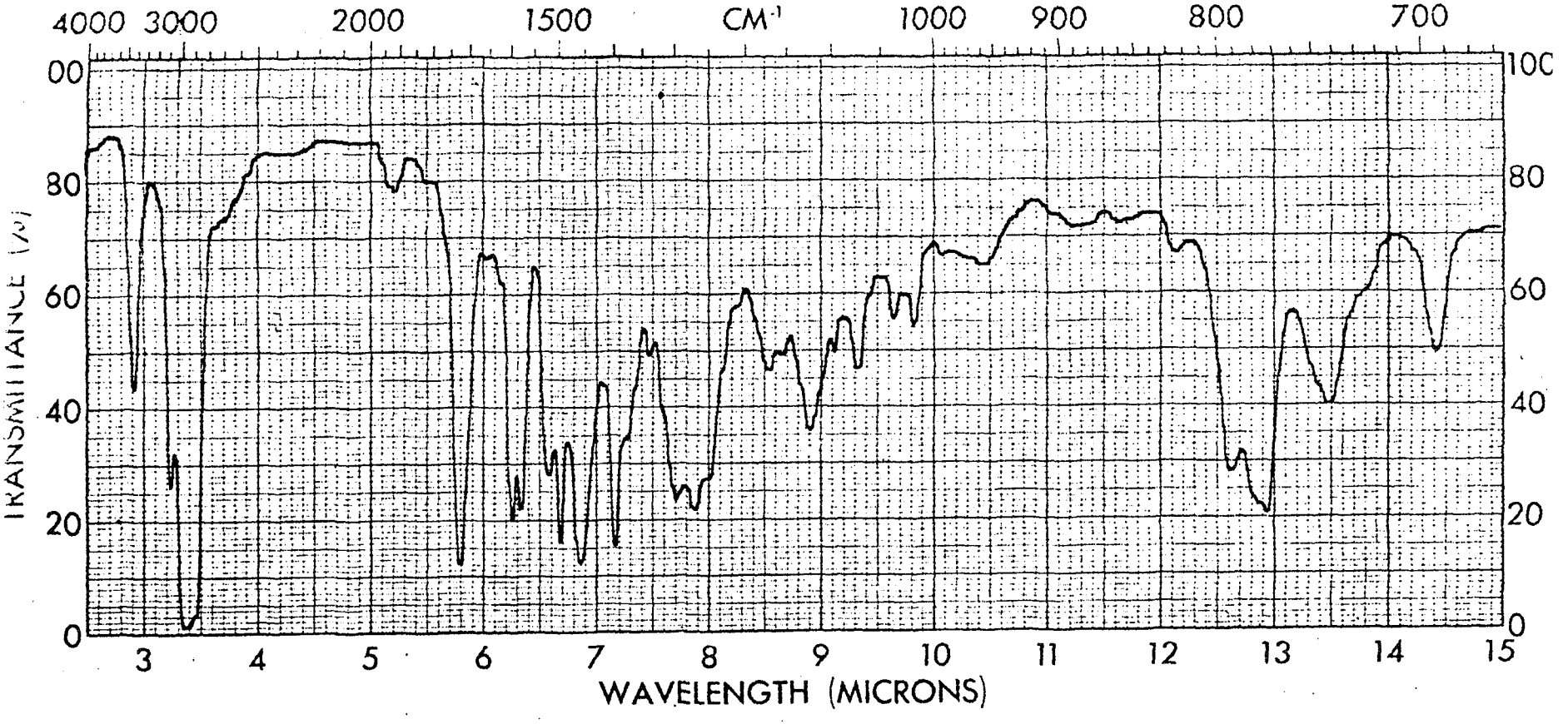
SAMPLE

18



SPECTRUM NO. 100 c	ORIGIN	LEGEND	REMARKS
SAMPLE 665, Vac. test at 225°F. Cream to liquid semi-solid		1.	
	PURITY Unk	2.	
	PHASE Semi-solid	DATE 6/21/63	
to Hi. Vis. Oil + Mg Comp. at end	THICKNESS Unk	OPERATOR E.B.K.	

ARDEL CORPORATION

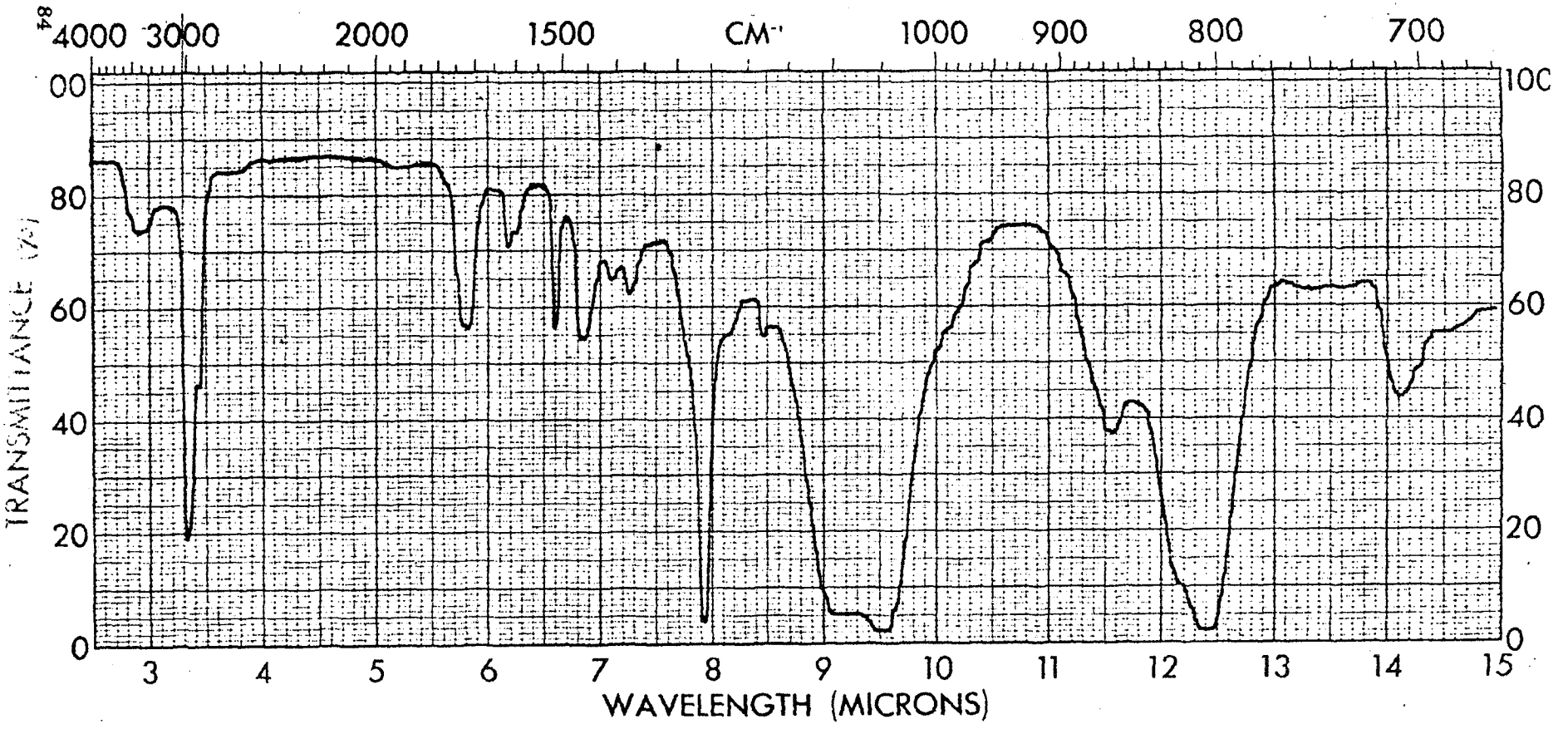


SPECTRUM NO. 107a	ORIGIN	LEGEND	REMARKS
SAMPLE C+S, 1/4c. test at 225°F. Amber Oil		1.	
	PURITY Unk	2.	
Liquid collected at room temp area.	PHASE Liquid	DATE 9/5/63	
	THICKNESS Unk	OPERATOR E.S.W.	

ARDEL CORPORATION

SAMPLE

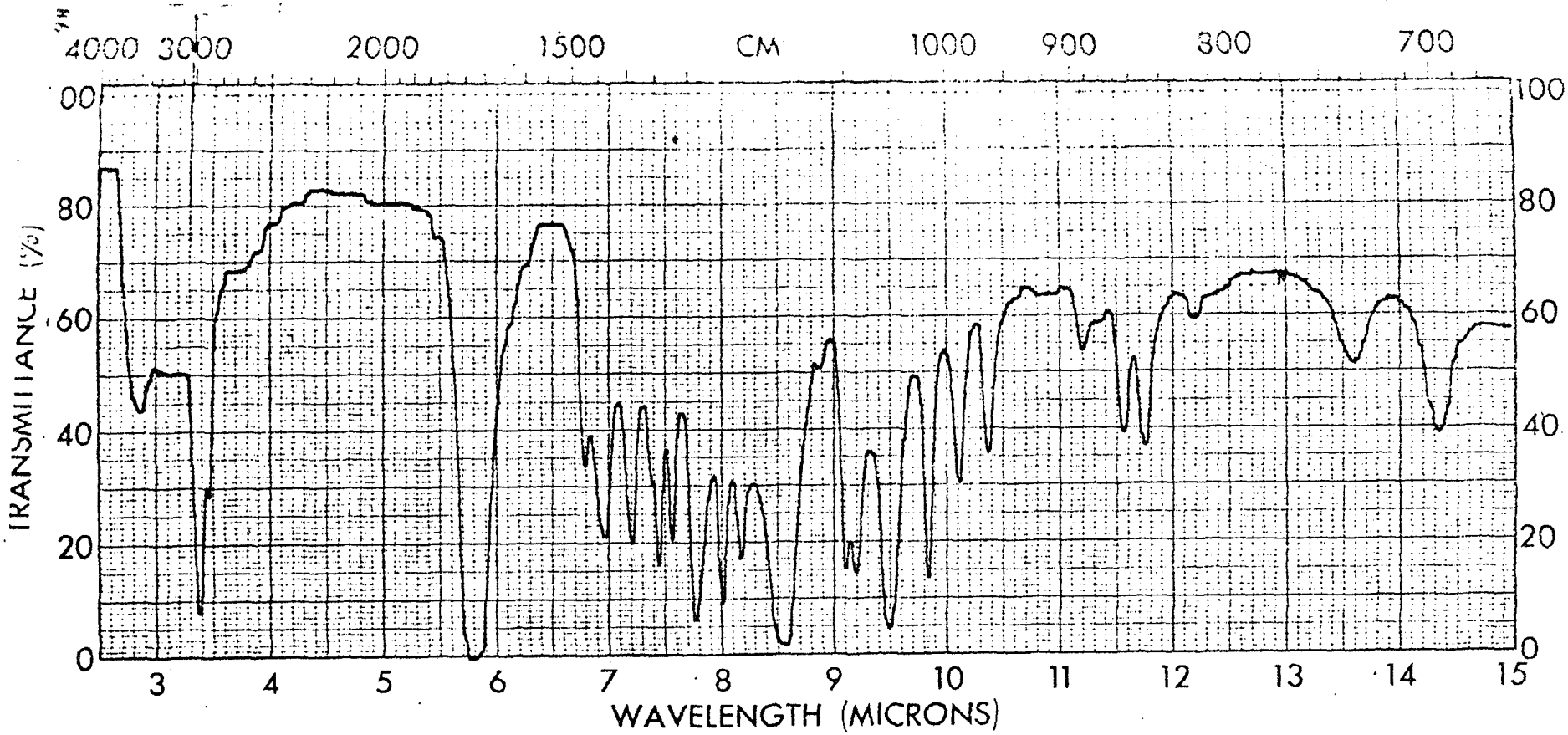
83



SPECTRUM NO. 1186	ORIGIN	LEGEND	REMARKS
SAMPLE 8635, Vac. Test at 225°F. Lt. clear yellow liquid collected at bottom of LN U-trap.	PURITY Unk	1.	
	PHASE Liquid	2.	
	THICKNESS Unk	DATE 9/23/63	
		OPERATOR EBW	

ARDEL CORPORATION

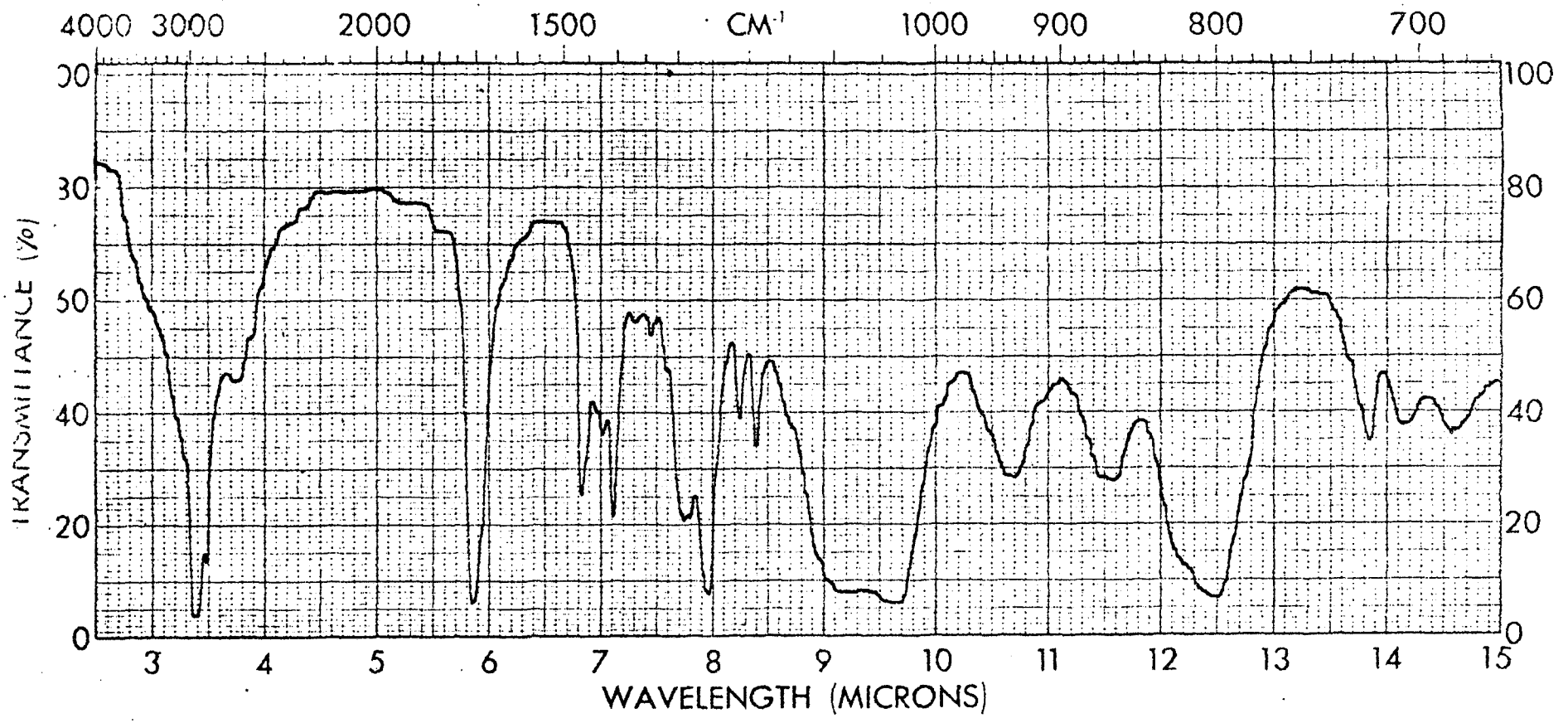
SAMPLE



SPECTRUM NO. 1226	ORIGIN	LEGEND	REMARKS
SAMPLE R56, Vac. test at 225°F. Clear Lt. red Liquid collected at bot- tom of Lit U trap		1.	Odor - ester
	PURITY Unk	2.	
	PHASE Liquid	DATE 9/20/63	
	THICKNESS Unk (Film)	OPERATOR FBV	

ARDEL CORPORATION

SPECTRUM NO.—
SAMPLE



SPECTRUM NO. 120c	ORIGIN	LEGEND	REMARKS
SAMPLE Bc26, Vac. test at 225°F. Translucent		1.	
	PURITY Unk	2.	
Liquid collected at LN2 temp.	PHASE Liquid	DATE 9/23/63	
	THICKNESS Unk	OPERATOR BK	

ARDEL CORPORATION

SPECTRUM NO. _____
SAMPLE _____

85